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ANALYSIS OF O-5 PROMOTION AND RETENTION FOR NAVAL URL OFFICERS

Hagen, Jaylyn D.; Pryor, Michael R.

Monterey, CA; Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

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ANALYSIS OF O-5 PROMOTION AND RETENTION FOR NAVAL URL OFFICERS

by

Jaylyn D. Hagen and Michael R. Pryor

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Thesis Advisor:	Simona L. Tick
Co-Advisors:	Nicholas Dew
	Sae Young Ahn

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The U.S. Navy is currently considering a transformation of its personnel performance evaluation system to ensure retention and promotion processes that are less subjective and contribute to a more efficient personnel management system. In this thesis, using an integrated quantitative and qualitative approach, we examine the process and criteria used by the U.S. Navy to select officers from the unrestricted line (URL) for O-5 promotion. We find that the Navy lags in using personality traits and measures of emotional intelligence metrics in its leadership selection and promotion processes, metrics that are considered increasingly important in selecting leaders in the civilian sector. We use historical personnel records to estimate predictive O-5 promotion models in the URL community. Officers' educational background is the closest measure we have from the existing Navy personnel data when trying to distinguish between officers more likely to exhibit hard skills (associated with technical degrees) versus soft skills (associated with non-technical degrees). We find that officers with technical degrees promote to the O-5 rank at similar rates with officers with either a mix of technical and non-technical degrees or those with exclusive non-technical degrees. We recommend that the Navy start collecting measures of personality traits and emotional intelligence to use in more efficient, less subjective personnel selection and promotion processes.

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ANALYSIS OF O-5 PROMOTION AND RETENTION FOR NAVAL URL OFFICERS

Jaylyn D. Hagen
Lieutenant, United States Navy
BA, University of Oklahoma, 2012

Michael R. Pryor
Lieutenant, United States Navy
BA, Lewis & Clark College, 2011

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Approved by: Simona L. Tick
Advisor

Nicholas Dew
Co-Advisor

Sae Young Ahn
Co-Advisor

Marigee Bacolod
Academic Associate, Graduate School of Defense Management

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ABSTRACT

The U.S. Navy is currently considering a transformation of its personnel performance evaluation system to ensure retention and promotion processes that are less subjective and contribute to a more efficient personnel management system. In this thesis, using an integrated quantitative and qualitative approach, we examine the process and criteria used by the U.S. Navy to select officers from the unrestricted line (URL) for O-5 promotion. We find that the Navy lags in using personality traits and measures of emotional intelligence metrics in its leadership selection and promotion processes, metrics that are considered increasingly important in selecting leaders in the civilian sector. We use historical personnel records to estimate predictive O-5 promotion models in the URL community. Officers' educational background is the closest measure we have from the existing Navy personnel data when trying to distinguish between officers more likely to exhibit hard skills (associated with technical degrees) versus soft skills (associated with non-technical degrees). We find that officers with technical degrees promote to the O-5 rank at similar rates with officers with either a mix of technical and non-technical degrees or those with exclusive non-technical degrees. We recommend that the Navy start collecting measures of personality traits and emotional intelligence to use in more efficient, less subjective personnel selection and promotion processes.

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LIST OF ACRONYMS AND ABBREVIATIONS

AZ	above zone
CNA	Center for Navy Analysis
CNO	Chief of Naval Operations
CoE	Culture of Excellence
DoD	Department of Defense
E4S	Education for Seapower
FC	field code
FITREP	fitness reports
FY	fiscal year
GPA	grade point average
IZ	in zone
LCDR	lieutenant commander
LDL	Leadership Development Level
LPM	linear probability model
MSR	minimum service requirement
NDS	National Defense Strategy
NFO	naval flight officer
OCS	officer candidate school
OLS	ordinary least squares
OPINS	officer personnel information system
OSR	officer service record
PERS	public employees' retirement system
PFT	physical fitness test
PSR	performance summary report
RL	restricted line
ROTC	reserve officer training corps
SECNAV	Secretary of the Navy
SECVANINST	Secretary of the Navy instruction
STEM	science, technology, engineering, and math
SUB	Submarine Officer

SWO	Surface Warfare Officer
YCS	years of commissioned service
YOS	years of service
URL	unrestricted line
USNA	United States Naval Academy

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EXECUTIVE SUMMARY

The U.S. Navy is currently considering a transformation of its personnel performance evaluation to insure retention and promotion processes that are less subjective and that generate metrics that are more useful for efficient personnel management.

In this thesis, using an integrated quantitative and qualitative approach, we examine the process and criteria used by the U.S. Navy to select officers from the unrestricted line (URL) to promote to mid-level leadership ranks.

First, we analyze the O-5 promotion board processes and practices, to compare them with private-sector best practices for mid-, and high-level leader selection. One of the main findings is that the Navy lags in using personality traits and measures of emotional intelligence metrics in its leadership selection and promotion processes, metrics that are considered increasingly important in selecting leaders in the private sector.

Using historical records from longitudinal personnel files, we estimate predictive O-5 promotion models to better understand the criteria used in the past by the U.S. Navy in its decisions of selection and promotion to the O-5 rank in the URL community. We find that URL officers from ROTC and the USNA commissioning sources were more likely to become mid-level leaders in the Navy, as they tended to have higher levels of retention at 15 years of service and were more likely to promote to the rank of O-5, when compared with OCS officers, conditional on retaining to at least ten years of service. Minorities consistently showed lower likelihood of retention and promotion to the rank of O-5 than the majority white male officer. Confirming previous findings that measures of intellectual ability (such as IQ scores, SAT scores, or GPA) are strong predictors of performance, we find that, regardless of the type of degree (technical, or non-technical) officers who graduate from top level schools were more likely to promote to O-5, while officers with degrees from low-ranked schools were less likely to promote, when compared with those with degrees from mid-ranked schools.

The officers' educational background is the closest measure we have from the existing, off-the-shelf Navy personnel data when trying to distinguish between officers more likely to exhibit hard-skills (associated with technical degrees) versus soft-skills (associate with non-technical degrees). We find that officers with technical degrees in the URL communities promote to the rank of O-5 at similar rates with officers possessing a mix of technical and non-technical degrees (for example, an engineer with an MBA degree) or exclusive non-technical degrees. We also find that even if a technical (STEM) degree was obtained at a high-ranking university, it has little to no association with probability of promotion to O-5. This finding could be due to several factors which could quite possibly be that officer undergraduate educational backgrounds may not play a large role in an officers' probability of promotion at the middle manager level.

It might be the case that technical degrees, associated with hard-skills, are more valuable for officers' performance earlier in their career, and less so when they reach mid- to high-level leadership ranks. However, it could be that the current process of naval training and natural annual attrition may contribute to the composition of officers who retain at ten years of service to be to be much more homogeneous regarding skills and performance. This homogeneity would be regardless of an officer's relative aptitudes and cognitive ability that they possessed when they first entered the Navy. Lastly, and perhaps the most important point, is that educational background may not be the best way to capture measurable and meaningful differences in the officers' personality traits and emotional intelligence metrics.

The current promotion board process has potential biases that could be further reduced if the evaluation and selection system included personality and emotional intelligence measures, like much of the civilian industry, to support identifying the most productive and successful leaders for the future. We recommend that Navy starts collecting measures of personality traits and emotional intelligence to use in a more inclusive, less subjective, selection and promotion process.

I. INTRODUCTION

In his summary of the 2018 National Defense Strategy (NDS), former Secretary of Defense, Jim Mattis, outlined the need for the U.S. to bolster its advantage in the face of an eroding competitive advantage over our adversaries. In his remarks, he articulated a sense of urgency for moving the country forward, on a path that supports the needed transformation.

> To succeed in the emerging security environment, our Department and Joint Force will have to out-think, out-maneuver, out-partner, and out-innovate revisionist powers, rogue regimes, terrorists, and other threat actors. (NDS, 2018, p 5)

He went on to address the importance of talent management as a critical part of the needed transformation.

> Developing leaders who are competent in national-level decision-making requires broad revision of talent management among the Armed Services, including fellowships, civilian education, and assignments that increase understanding of interagency decision-making processes, as well as alliances and coalitions. (NDS, 2018, p 8)

As highlighted in the NDS, talent management is at the forefront of Navy's manpower mission. If the goal is to continue to improve the policies and procedures associated with the Navy's retention and promotion system, then we need to examine these selection criteria and their past outcomes and to evaluate whether there are any areas that would require improvement.

Prior to the publishing of the NDS, the Navy published the Sailor 2025 initiative, which brought numerous policy changes geared towards talent management. The overarching goals are to retain and promote the best and the most talented, and develop sailors to make the naval force more lethal. The end state the Navy is striving for is a naval force that has a competitive advantage over our adversaries (Richardson, 2016). The Navy has also begun to increase its emphasis and value of education and training. The education for sea power study (E4S), clearly explained the importance of education and training that is necessary to build a more competent and lethal naval force (Washington, DC: 2019).

The expectations are that our adversaries are stressing education and training to gain a competitive advantage over our force, so we must do the same. However, “retaining” more officers is not the answer. It is instead critical to examine who we retain and promote, and if these officers’ key assets align with Navy values and the demands of the NDS.

Lastly, to stress the importance of the topic, the Chief of Naval Operations, Admiral Gilday recently released fragmentation order 01/2019 to the Navy. The order emphasizes the focus shifts to be expected in the Navy to maintain maritime superiority during our growing great power competition with near peer adversaries. Admiral Gilday’s expectation for warfighters (Navy sailors) is a “world-class naval force though recruitment, education, training, and retention of talented American men and women” (Gilday, 2019, under “Warfighters”). In other words, he states that we want to retain and promote our best, brightest, and highest performing naval officers. The CNO sets an expectation that we as a Navy must build on a Culture of Excellence (CoE) moving forward. He endorses using all available tools to allow senior leaders to intervene before destructive behaviors arise, meaning we need to continue to build on signature behaviors, those which capture the high ideals espoused in the Navy’s Core Values of Honor, Courage, and Commitment. Gilday (2019) reiterates these behaviors and values are what the naval force needs to be comprised of to become the “world-class naval force”. For decades, similar guidance has led to the current processes in place to filter out unfit naval officers and ideally promote and retain the “stars”.

Given the above guidance, it is critical to ask the question: is the Navy retaining and promoting the “right” people? Specifically, what criteria is the Navy using to promote one officer over another, and does this align with the Navy’s core values and the CNO’s design for maintaining maritime superiority in our world of great power competition? Are there certain characteristics or demographics associated with higher promotion and retention rates? What does the data show? How can these procedures be improved to better select and promote the most highly qualified and highest performing URL officers to further advance the Navy’s strategic personnel management strategy?

To best answer these questions, this research will use Navy officer personnel data to estimate predictive models for O-5 promotion. We will also conduct an in-depth analysis of selection criteria for SWO/SUB senior officers and how they align with civilian industry given that to remain competitive with the ever-changing civilian job market, the Navy needs to be able to stay competitive with their recruiting and screening policies.

- Primary Research Questions

1. What professional, educational and demographic characteristics predict O-5 promotion outcome for Navy URL officers?
2. How do these predictive powers vary for different URL officer categories (race, ethnicity, SWO versus SUB)?

- Secondary Research Question

1. What are the recommendations or lessons learned from civilian industry selection procedures that can be incorporated into the Navy's policies and procedures?
2. What selection procedures and outcomes can be tested with current data from the Navy and what metrics are most critical for the Navy to start to collect?

The purpose of this thesis is to thoroughly examine the promotion board processes and criteria while comparing it to the acquired personnel and promotion data. In the following chapters we will highlight takeaways from how the civilian industry conducts promotion of talent, describe the naval officer statutory O-5 promotion board process, conduct a quantitative literature review on quantitative studies of personnel and promotion, and lastly present our analysis, results, and recommendations.

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II. LITERATURE REVIEW

A. WHAT PREDICTS PROMOTION OUTCOMES IN THE NAVY?

As previously mentioned, our primary research questions are as follows:

1. What professional, educational and demographic characteristics predict O-5 promotion outcome for Navy URL officers?

2. How do these predictive powers vary for different URL officer categories (race, ethnicity, SWO versus SUB)?

The motivation of our research is to answer the stated questions. However, we understand that performance outcomes (such as O-5 promotion), are associated with retention. Observing officer O-5 promotion outcomes would require officers to still be in the Navy in active duty status. Therefore, we examine the recent literature with respect to retention at the career point closest to O-5 promotion. In addition, we analyzed the literature in relation to officer success as measured by various performance outcomes through an officers' career.

B. RETENTION LITERATURE

1. Models for Measuring Officer Retention

Foster (1990), Maugeri (2016), Moss (2018), Lehmann (2019), and Menichini and Tick (2019) all chose similar methodologies with respect to retention models. The most commonly used retention model is retention at the minimum service requirement (MSR). MSR is the minimum service obligation an officer is required to complete upon commission. The amount of time required for officers varies by accession source. For example, most officers who commission through the USNA are required to serve five years, where officers who commission through OCS are required to serve four years. MSR is an important measurement for the Navy because it will provide insight to how well the Navy is retaining its officers and it will aid in determining the return on investment for various accession sources. Maugeri (2016), Moss (2018), Lehmann (2019), and Menichini and Tick (2019) also utilized 10-year retention models in their research. These models were used to aid in determining how many officers were staying beyond their MSR.

2. Retention Models That Include the Effects of STEM Degrees

In 2016, Maugeri finds that STEM degrees can have a significant and positive predictive effect on probability of promotion beyond MSR. Furthermore, he finds that a STEM degree can also increase the probability of an officer staying beyond ten years of service as well as being promoted to O-4. These results partially refute previous research that found that STEM degrees have no effect on promotion and the presumption that officers with STEM degrees would be more likely to leave the Navy for civilian sector opportunities.

To the contrary, Moss (2018) finds a negative effect of STEM degrees on retention. Moss attributes his contrary findings to the methodology used by Maugeri with respect to coding officers with a STEM degree or not. Unlike Moss, Maugeri (2016) compared the outcomes for officers with STEM degrees with the aggregate category of officers with either a non-STEM degree or an unknown degree. In his work, Moss separates the categories of officers with unknown degree from those with non-STEM degree to avoid a potential positive bias from the STEM degree variable. In our analysis, we follow the same approach as Moss (2019).

Lastly, with respect to the predictive effect of STEM degrees on officer retention, in 2019, Menichini and Tick find that, after separating their data sample into URL and RL/STAFF officers, none of the individual STEM and non-STEM degrees has a consistent effect on retention. The only exception the authors find worth mentioning is that RL/STAFF officers with an engineering degree seem to be less likely to remain in the force at both six and 10 years of service. With respect to accession source and demographics, the authors also find that females and graduates from the USNA or ROTC (as opposed to OCS) are less likely to remain in the force at the six- and 10-year marks, both for URL and RL/STAFF officers.

3. The Effects of College Quality/Selectivity on Retention

Lehmann (2019) chose to evaluate the relation between undergraduate college selectivity of officers and retention. He finds that officers who have degrees from undergraduate institutions with high tuition expense are more likely to leave after completing their contractual service time and enter a civilian work force.

Menichini and Tick (2019) also examined the predictive effects of officers' college quality on officer retention. Using Baron's college quality rating system, the authors broke down officers' college educational backgrounds to be able to determine if officers' education could be classified as high quality. The researchers find some evidence that officers' classified as having a high-quality university educational background are less likely to retain beyond MSR and ten-years of service. We will include measures of college selectivity in our analysis.

4. Retention Models Beyond Ten Years of Service

Fewer studies have examined officer retention out to 15 years of service. Pitzel (2018) analyzed the predictive effects of Navy funded and self-funded graduate education on retention and performance of naval officers. Pitzel examines officer retention at 12 and 15 years of service to find that, in the URL community, when accounting for the type of institution that granted the funded graduate degree, URL officers with funded graduate degrees from military institutions have statistically significant higher twelve-, and fifteen-year retention rates compared with officers with a self-funded graduate degree. He also finds that in the RL and Staff community, officers with funded graduate degrees have better rates of fifteen-year retention when compared with officers with self-funded graduate degrees. Lastly, he finds, that RL/Staff officers with funded graduate degrees, whether from military or civilian institutions, retain at the same rate at twelve year as the RL and Staff officers with self-funded graduate degrees. While our thesis only focuses on URL officers, similar to Pitzel, we will estimate 15-year retention models, and we will account for graduate degrees and their specialties.

5. Summary

Based on the above literature, education (both undergraduate and graduate), demographics, STEM degrees, accession source, and designator all play some sort of role in retention. We intend to further the insights brought in by this category of research with estimates of predictive models for retention at fifteen-years of service. Our retention model will most closely align with Pitzel (2018) but will also consider the approaches from the authors previously mentioned.

C. OFFICER PERFORMANCE/PROMOTION LITERATURE

When analyzing the literature on naval officer performance or success, there are reoccurring themes with respect to measuring officer success. Most researchers use officer promotion as a measure of officer success. While doing so, most researchers also include and control for common key explanatory variables. This literature review will examine the research findings on measurement of officer success. The following performance outcomes are typically used to measure officer success: officer promotion, combination of promotion and fitness report scores, and officer promotion and command screening outcomes.

1. Officer Performance Measured by FITREP, Promotion, and Combination of Both

Foster (1990) investigates whether officers from different commissioning sources (USNA, NROTC, OCS) differ in performance. Foster limits his research to the submarine and surface warfare communities and utilizes various performance indices based on officer fitness reports to conduct multivariate regression analysis. As a main takeaway, Foster found some evidence that USNA graduates tend to have a higher probability of being rated superior performers compared to OCS and NROTC graduates. He also found that USNA graduates were slightly more likely to be recommended for early promotion, however not significantly different in retaining beyond minimum service requirement. Lastly, Foster (1990) finds that academic major and ethnicity to have inconclusive evidence with respect to officer performance and retention.

Similarly, O'Connell (1998) measures job performance in two different ways: (a) the percentage of evaluations of an officer that included a "recommendation for early promotion" during grades O-1, O-2, and O-3 (FITREP scores), and (b) promotion to grade O-4. He investigates whether college quality, college major, and GPA are correlated with job performance for a sample of Navy officers. He finds that college selectivity and GPA are positively correlated with officer performance. However, he reports mixed empirical evidence about college major. For instance, he finds that a technical degree is negatively correlated with obtaining a recommendation for early promotion for RL/STAFF officers from grades O-1 through O-3, while a business/management degree has some positive effect on being promoted to grade O-4.

In addition, Maugeri (2016), Moss (2018), Lehmann (2019), and Menichini and Tick (2019) examined officer performance as measured by FITREP scores and promotion or a combination thereof. Maugeri (2016) finds that a STEM degree increases the probability of retention and promotion for an O-4, while it has a negative effect on an individuals' Fitness Report average. Moss (2018) finds that URL officers with STEM undergraduate degrees have an O-4 promotion rate that is 2.8 percentage points higher. Conversely, he finds there is no effect of STEM degrees on the O-4 promotion rate for RL/Staff or RL-only officers. Menichini and Tick (2019) find that, with respect to FITREP scores and promotion, the impact of the individual STEM and non-STEM degrees is unclear. Lehmann (2019) finds that choice in school has less effect on career success then commission source, date of commissioning, the community joined, and changes in household demographics. He also finds that there are no statistically significant findings from his study that suggest that elite schools influence promotions to O-4.

In 2002, Bowman and Mehay also chose to measure officer success through means of officer FITREP scores and promotion outcomes. The authors extensively analyzed the effects of college quality and individual academic background on selected performance outcomes for officers with managerial occupations in the U.S. Navy (2002). The goal of the authors' research was to provide insight into the connection between a person's college background and a person's performance in a firm. The authors used detailed data of naval officer cohorts FY 1976-1985 and tracked them for ten years or until they departed the Navy (2002). Using officer performance evaluation data, Bowman and Mehay found that officers who graduated from top-rated schools, either public or private, were more likely to receive higher performance ratings as junior officers and were also more likely to promote at required times in their career. The authors' findings show strong evidence that high ability, as measured by college grades and GPA is a strong predictor for receiving higher performance evaluations and a higher likelihood of being promoted (2002). Lastly, despite the Navy's longstanding emphasize on recruiting officers who earned college degrees in technical fields, the authors found little evidence to support the link between officers with technical degrees and higher performance in the fleet.

2. Officer Performance Measured by Promotion, Command Screening Outcomes or Combination of Both

In 1993, Saw researched naval officer performance outcomes. Saw specifically examined probability of promotion to lieutenant commander (LCDR) over the period of fiscal years 1985-1990 for surface warfare officers and submarine officers (1993). Like Bowman and Mehay, Saw's analysis included naval officer education backgrounds, personal demographics, officer accession source, and college GPA and their effects on officer performance measured by promotion. However, Saw included graduate education and officer advance qualification designators (AQDs). Saw derived results from data from the LCDR selection boards during the years 1985-1990. He found that for surface warfare officers, promotion to the rank of O-4 was higher among those officers who commissioned through the United States Naval Academy (USNA) compared to those who commissioned through OCS or ROTC (1993). For academic background, Saw found that officers who earned higher undergrad GPA's were nearly 10% more likely to promote to O-4 than those with average or low GPA's (1993). Saw's findings also provide evidence supporting Bowman and Mehay's (2002) research relating to college selectivity, where he found that officers from highly ranked colleges (according to the Barron's college ranking) were over 10% more likely to promote than those from average or lower ranking schools (1993).

Additionally, with respect to graduate education and its effect on promotion probability, Saw (1993) found that officers who earned a graduate degree were nearly 15% more likely to promote than those officers who did not. Breaking it down even further, graduates from the Naval Postgraduate School were 22 percentage points more likely to promote than those from other institutions (Saw, 1993). Similar to Bowman and Mehay's

(2002) findings with respect to officers with technical degrees, Saw found that officers with technical undergrad degrees have only a 2-percentage point higher advantage on those nontechnical graduates (1993).

Similarly, Pitzel (2018) examined officer success defined by promotion outcomes to the grades of O-4 and O-5. He finds that, in the URL community, officers with funded graduate degrees have higher O-4 and O-5 promotion rates when compared with self-funded graduate degrees. He also finds that in his probit promotion models, O-4 and O-5 promotion rates for URL officers are higher than those of URL officers with unfunded graduate degrees regardless of whether they were from a military or civilian institution.

In addition to officer promotion outcomes, Fuchs (1996) examined officers' probability of screening for command. Screening for command occurs during a URL officers' career path depending on community. It is a board process in which only the most qualified officers are selected. Using Navy officer Promotion history files from the Bureau of Personnel, Fuchs used three different increasingly inclusive probit models to determine the effects on promotion and then command screening caused by demographics, graduate level education, accession source, past FITREP ratings, and age at commissioning. Fuchs finds strong evidence to support that graduate level education led to higher levels of promotion and retention at the time of the officer's O-4 board, especially with fully funded graduate education programs like the Navy Postgraduate School. Of note, Fuchs also finds that at the O-5 promotion level, technical degrees and fully funded master's degrees were significantly higher correlated with promotion, while nontechnical degrees are more highly associated with promotion at O-6.

Lastly, research to mention with respect to officer performance is that of Parcell et al (2003). The authors estimated multivariate models to determine whether accession source influenced the probability of achieving various career milestones, while holding constant other observable officer characteristics (e.g., undergraduate major and performance, school selectivity, race/ethnicity, gender). The career milestones the authors observed were promotion to O-3, O-4, and O-5, screening for command at sea, and promotion to O-6. The authors used URL officer accessions from FY76 to FY96. We would like to highlight three of the authors' main findings. First, they found that accession source is associated with early career success (e.g., accession source affects the estimated probability of promotion to O-3). Second, in general, above-average (or, in some cases, below-average) undergraduate grades have a positive (negative) effect on the probability of achieving career milestones even as far into the career as screening for command at sea. The authors do however note a caution with respect to interpreting their results with respect to officer GPA. They are not saying that better grades equal a longer officer career but rather that a higher GPA may be a proxy for a mix of ability, good organizational and time management skills, attention to critical detail, and other attributes that likely underlie success in both academic coursework and the officer corps (2003). Lastly, the authors found that competitiveness of the undergraduate school attended, undergraduate major, and technical proficiency as reported in the academic profile code did not have a consistent (or, in many cases, any) effect on the estimated probability of promotion.

3. Summary

Our thesis will most closely align with Pitzel (2018) and the research done by the Center for Naval Analysis research conducted by Parcell et. al (2003). As previously mentioned we intend to examine retention our to 15 years of service and officer performance measured by O-5 promotion. Given that Pitzel (2018) and Parcell et. al (2003) both thoroughly reviewed officer performance out to the O-5 grade, we intend to conduct our research similarly. Given the vast amount of research covered, we also intend to control for numerous variables based on what our data allows. This will include variables such as graduate education, degree type (technical versus non-technical), various demographics, community type, and commissioning source. Our intent is to update officer promotion field of research with younger officer cohorts to determine if our findings more or less align with previous research and if it aligns with the Navy's overall strategy of "talent management" given our present and projected global strategic environment.

III. ANALYSIS OF CIVILIAN INDUSTRY SELECTION PRACTICES

A. PROFILING LEADERSHIP AND EFFECTIVENESS

Past research of the Navy promotion process has not been able to identify soft skills simply because the Navy does not have a means to measure them. We want to determine if there is some missing variable in our analysis; where the results indicate that the board seems to be selecting for promotion on a certain set of characteristics, when in fact there is a variable that is unaccounted in the analysis which is actually the dominate predictor of promotion. We expect many of the predictive traits in our analysis not to be related to soft skills, we hope to uncover if there are any hidden traits that may differentiate more top performing SWOs, using the following civilian selection criteria as a guide. For our research, we will investigate how these traits, identified across the civilian industry, compare to the predictors of performance and the promotion process for O-5 SWOs in our analysis. This section comprises several studies that investigate the civilian selection criteria associated with higher levels of performance and leadership, regardless of industry.

Past research shows that all candidates for leadership or management must possess a collection of knowledge and skills from four general categories: technical, social, organizational, and cultural. After a comprehensive review of many attributes and traits that various companies sought in future management candidates, Bartlett and Ghoshal (1997) identified the most important organizational management competencies. At the "senior-management developer" level, requisite traits for success included being supportive, patient, integrative, flexible, perceptive and demanding. However, at the "top-level leader," successful characteristics were more centered on benefiting the institution rather than the subordinates under the manager. These traits included challenging, stretching, open-minded, fair, insightful, and inspiring. Bartlett and Ghoshal's research found that of the many organizations that they observed, the ones that solely used accumulated knowledge and job experience as the basis for choosing their higher-ranking leaders were not as successful as organizations that used a unique combination of personality characteristics, as well as knowledge and skills (1997). At higher levels of management most candidates possess high levels of intellect and skills, however it is more likely soft skills that differentiate the top-performers from their peers (Day & Sessa, 2003).

Lahey (2014) also identified critical personality characteristics that should accompany knowledge and experience for predicting the success of future managers. He studied over 8,800 organizations since 1955, spanning across several industries that were using normal and work-related personality traits to more accurately match individuals with the most suitable promotion (Lahey, 2014). Lahey identified that through behavioral assessments of future leaders you can leverage an individual's motives and drives, allowing a better job match. Organizations use these assessments to select and promote based on personality, rather than just knowledge and skill. Lahey concluded that personality traits like dominance, extroversion, patience, formality, decision-making, and response-level have a direct and substantial (nearly 20-25%) impact on an individual's effectiveness on the job (Lahey, 2014, pp. 25-26).

Since there is so much research relating leadership ability to myriad background characteristics and personality traits to job performance, McCauley et al in 2006 attempted to use the Constructive-Developmental theory to see how it contributes to an individual's ability to manage and lead (McCauley et al, 2006). In their analysis, the definition of Constructive-Development theory is the advancement of an individuals' understanding of themselves and the world around them effects the way they interact with others. Although McCauley et al. had mixed results to support this theory, it has been involved in several research studies since to advance knowledge of how an individual's personality, plus their other characteristics, may predict different levels of effectiveness (McCauley et al, 2006).

Strang used the same Constructive-Developmental theory to compare how Leadership Development Levels (LDLs) are associated with different degrees of leader performance (Strang & Kuhnert, 2009). Strang used the Big Five personality traits, a known predictor of leader performance, as a basis for his comparison. The Big Five, or the five-factor model of personality, is a well-understood model to measure an individual's normal personality (Strang & Kuhnert, 2009). The Big Five used Strang & Kehnert's analysis were extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. All these traits are related to the personality traits found by Lahey and

Bartlett's research, having to do with an individual's response-level, interaction with others, leadership style, and intellect; over time they became generalized and known as the Big Five.

The LDLs, in Strang and Kuhnert's research, were associated with different levels of self-awareness, and provide insight into how much an individual is aware of their his/her goals, interactions with others, and advanced understanding of surrounding value systems. As the LDLs increase in number the amount of understanding about oneself and others, is rated higher for the individual. The results of their analysis found that as the LDL increased so did the individual's average performance ratings on the job. They also found that with higher LDL, the stronger the correlation to leader performance rated by peers and subordinates. In their analysis they provide strong evidence to support the Big Five personality traits were associated with higher levels of leader's performance especially when coupled with a higher LDL for an individual. Of the Big Five, Conscientiousness, Extraversion, and Openness more significantly led to a strong leader performance, and those with higher scores on average for the Big Five will have a higher LDL. Interestingly, an unintended finding from this study was the importance of peer/subordinate ratings of the managers and the association with performance; higher performance ratings were strongly correlated to higher ratings from an individual's peers and subordinates (Strang & Kuhnert, 2009).

Dave Bartram in 2005 also investigated the validity of ability and personality traits being associated with different levels of performance on the job. Like several other research articles regarding these characteristics that predict performance like the Big Five, Bartram categorized several personality and ability characteristics into what he called the Great Eight. The Great Eight pairs traits that are highly interconnected, including "leading and deciding, supporting and cooperating, interacting and presenting, analyzing and interpreting, creating and conceptualizing, organizing and executing, adapting and coping, and enterprising and performing" (Bartram, 2005, p 1187). Many of these categories incorporate other personality traits that we have seen in other research including extraversion, agreeableness, mental ability and openness, conscientiousness, emotional stability, and motivation, very similar to the Big Five. In contrast to other Big Five studies, Bartram attempted to separate the personality traits in his analysis and relate those solely to performance ratings of individuals, separating them from the more ability-based traits. He believed that this would provide more evidence that these traits were more telling of an individual's performance than simply ability-based predictors. Likewise, he wanted to show that "ability-based predictors will only relate to those areas of competency that are underpinned by job knowledge and skill acquisition" (Bartram, 2005, p 1188).

In his analysis he provides strong evidence that the Big Five in previous research articles are strongly correlated to the same characteristics included in the Great Eight; more interestingly, he found that the Big Eight were more encompassing of an individual's personality by including individual categories related to achievement and power, not used in the Big Five previously. The evidence shows that the ability-based competencies were strongly correlated with only ability of an individual and as expected the more personality-related competencies showed little relation to ability on the job (Bartram, 2005).

Bartram found that personality traits add significantly to the prediction of future performance of individuals, especially when combined with actual measures of ability. Specifically, he found that individuals are rated higher by managers on performance who are "dependable, high achieving, and focused on the task rather than those who display the prosocial behaviors of helping and supporting others" (Bartram, 2005, p 1199). He also concluded that these personality and ability characteristics may be important to predicting future behavior, but more importantly, they may be better assessment tools to choose the future leaders of an organization. Measuring the personality and ability traits of those that are successful could provide insight for an organization of what leads to higher levels of leadership and performance, and use them as criteria for selection and promotion (Bartram, 2005).

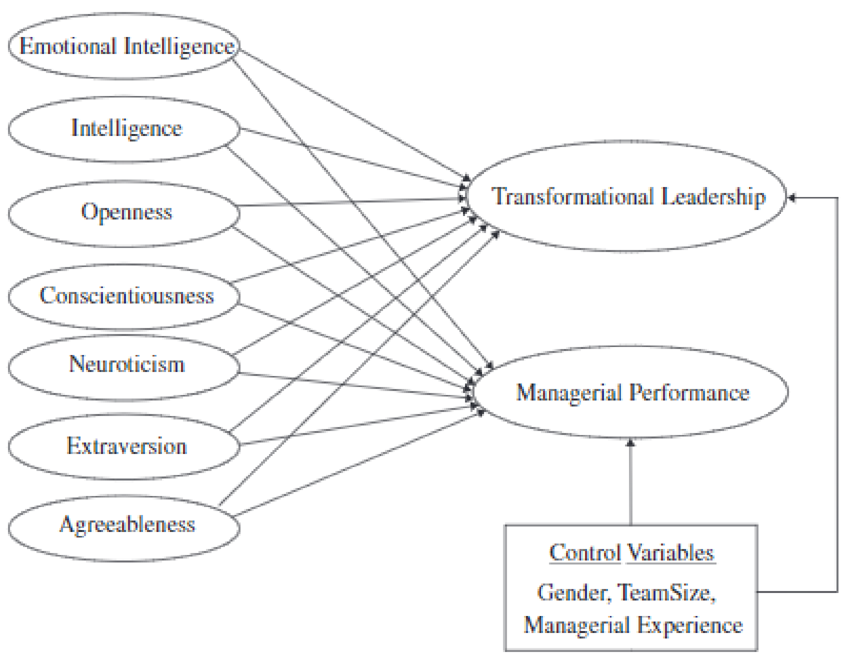
Joseph and Newman (2010) attempted to use the Big Five personality traits in a mixed model with emotional intelligence to predict job performance. They hoped that combining personality traits and cognitive ability with emotional intelligence would provide a fuller picture to predict overall job performance than previous research, which simply focused on personality traits and cognitive ability. Joseph and Newman (2010) found that emotional intelligence has strong overlap with the Big Five personality traits of consciousness and emotional stability as well as overall cognitive ability. Alone, emotional intelligence is simply redundant with the findings that include personality and cognitive ability; however, when used in a mixed model the predictive capability was substantially higher than models where emotional intelligence had been left out (Joseph & Newman, 2010).

A year later, another research article pertaining to emotional intelligence and performance was completed using a similar approach to Joseph and Newman. However, with updated data and a more inclusive approach to the variable of emotional intelligence, O'Boyle and his colleagues (2011) found that all types of emotional intelligence, even those portions directly related to cognitive ability, have high predictive capability for job performance. When all three measures of emotional intelligence including ability measures, self- and peer-report measures, as well as mixed models are integrated, they can predict job performance well above cognitive ability and personality factors alone (O'Boyle et al, 2011). O'Boyle and his colleagues go on to state that these factors should instead be viewed as complimentary measures of performance rather than competing variables. Understanding how the interaction between emotional intelligence, personality factors, and cognitive ability together can predict not only performance, could also help us to predict the quality of a leader in an organization.

Miao et al (2018) also believed there was more to being an authentic leader than just cognitive ability and personality. Their study proposed that emotional intelligence was a function of the personality traits and cognitive ability that a person possesses, and therefor would have a stronger relationship with performance than these characteristics could explain on their own. They found that emotional intelligence perceived by an individual was highly significant to predicting an authentic leader, while more ability based emotional intelligence has to do with ability toward job performance and less to do with leadership. Ability based emotional intelligence is more tied to performance of a specific job rather than overall performance as a leader (Miao et al, 2018). This also related to the findings associated with Bartram's Great Eight personality traits, where ability-based traits were only correlated with performance if the individual was evaluated on skill and ability directly related to the job description. (Bartram, 2005).

Expanding on these predictive models of leader and manager effectiveness, a research article about transformational leadership and its relationship to emotional intelligence and the Big Five personality factors was conducted in 2012 (Cavazotte et al., 2012). This article illustrates how these factors of emotional intelligence, cognitive ability or intelligence, and the Big Five personality factors work together to give a full picture of what characteristics create a transformational leader and effective manager in any organization. Figure 1 portrays a model that controls for variables like gender, experience, and organization size, and uses their combination of variables to predict an individual's performance as not only a leader but also an effective manager (Cavazotte et al, 2012, p 447). This diagram sufficiently illustrates how all the previous articles we have investigated that study this relationship between intelligence, personality, and emotional intelligence are all related to one another.

Figure 1. Effects of Individual Differences on Transformational Leadership and Performance. Source: Cavazotte et al. (2012).



The research also found that leadership effectiveness was a direct result of a leader's behavior and after accounting for individual differences, these characteristics indirectly affected the way that the leader behaved and managed. They concluded that especially regarding emotional stability, these factors of emotional intelligence may be more relevant to achievement in managerial roles than previously thought. They suggest that it is not a matter of *if* emotional intelligence effect leadership and management, but rather a matter of when, how, and to what degree these factors play a part in an individual's leadership for an organization (Cavazotte et al, 2012).

Other psychological characteristics and demographics like gender, age, ethnicity, and family situation can be useful to predict future performance (Kandogan, 2018). Studies that have to do with international assignment of employees have to make special considerations when considering the highest performing individuals because of the unique situations that their employees face. These situations are like those unique situations that an SWO may find himself in on a joint military assignment or even a deployment. Some of the findings pertaining to selection criteria for promotion or assignment in an international organization may be useful to the military for future policies regarding promotion and selection processes. We intend to include demographics and other background characteristics to our analysis to determine if any of the same trends or predictions like these other organizations that operate internationally.

Kandogan (2018) conducted a study to determine if these qualifications and characteristics had an impact on whether an individual was selected for an international assignment. In his research, he found that most importantly professional qualifications associated with the job are the most important predictor to being selected for an international assignment and other predictive characteristics are not as significant. However, when the manager in charge of the selection of that international candidate were considered, they found that family situation has a significant negative impact on international assignment, especially if the candidate has a similar family situation to the selection manager. In this case, those managers who reflected on their own experiences instead selected individuals who were single with no children for the international assignment vice their older more experienced peers. These "homophily" or "like me" phenomena will be later discussed in this chapter when characteristics of performance evaluators are analyzed using Leader-Member Exchange theory.

In a study done for the Royal Canadian Mounted Police regarding the effectiveness of their evaluation and promotion process, a similar combination of traits was utilized to measure the officer's effectiveness and probability of promotion based on performance (Catano et al, 2007). Interestingly, their supervisor evaluation process, and even their evaluation form, are both like the Fitness report used in the Surface Community for Naval officers. The officers are ranked upon their average performance of their core competencies and then evaluated by a performance review board. The core competencies used by Catano et al (2007, p 204) were "leadership, service orientation and delivery, thinking skills, personal effectiveness/flexibility, organization and planning, interpersonal relations, communication, and motivation." These traits are also very similar to the traits seen in the previous articles in this chapter which combine not only experience, but mostly personality traits that focus on interaction with others and self-awareness.

Their promotion system was much like the one used for the SWOs, with an aggregate score of the core competencies for each officer used as a basis for promotion, voted on by a performance review board. Using methodology like ours, Catano et al (2007) assessed the performance and characteristics of the officers, followed them over time, and then analyzed the results to see which characteristics led to higher levels of promotion rates for the officers. They found that on average a high score on their performance evaluation was associated with a very high level of promotion to the next rank. An interesting aspect of their study was that, after their analysis of promotion rates among the 6,571 officers, their system was successful at predicting promotion candidates without being influenced by outside bias factors such as gender (Catano et al, 2007). However, past research in civilian and military organizations has shown strong evidence that demographics, as well as other non-performance-based characteristics may be causing personnel biases in promotion and selection systems. The next section will discuss these biases and how they may be affecting the civilian selection processes.

B. IMPACT OF SELECTION BIASES

1. Academic Literature

Civilian Literature has also uncovered several anomalies with the different selection processes that are currently being used in civilian organizations. Several past journal and research articles from sociological and psychological references have shown strong evidence for several different types of biases involved in selection boards that are intended for making decisions regarding promotion, hiring, and retention. In several of the articles that we reviewed a selection or promotion board, much like the promotion boards in the Navy, are used to hire, promote, and retain employees across a variety of industries. Many researchers have uncovered that when this type of decision is presented to a promotion board, or a superior, often there are selections based from many characteristics that have little to do with actual job performance. This chapter will investigate several of these biases like "homophily" and leader-member exchange theory and their effect on selection decisions in an organization.

When it comes to competency versus likability, common sense would imply that competence is much more valued by a superior when deciding whether to select an employee for any career advancement. However, when tested, likability of an employee is nearly two times more likely to get an employee selected than their competence (Singh & Tor, 2008). Research has found that this likability stems from interpersonal attractiveness between the superior and the subordinate up for selection and it is called "homophily." This term was created in 1954 by Lazarsfeld and Merton to refer to the tendency for individuals to be more attracted to others who are like themselves, especially regarding gender, race, age, and past experiences (Lazarsfeld & Merton, 1954). Not only were similarities a strong indication of interpersonal attractiveness, but dissimilarities were found to be a strong negative reinforcement for selection decisions through the repulsion effect, and these effects were nearly three times as strong as the similarity effects (Tan & Singh, 1995). These differences among supervisors' evaluations dependent on the characteristics and likability of the subordinates is an example of Leader-Member exchange theory, where there has been significant proof throughout history that evaluators do not treat or evaluate all subordinates in the same way.

This Leader-Member Exchange theory not only includes the homophily aspect, but it also includes the phenomena where individuals are more likely to select someone who is more likable, than someone who is marginally more competent, with regards to job performance. Lower competence was associated with higher likability (warmth) and inversely high competence was associated with lower levels of warmth when managers from four organizations were analyzed and questioned regarding their selection decisions for people in their organization (Casciaro & Lobo, 2005). Organizations will almost always weed out the individuals who are not well liked or have very low competence, however when you consider the two categories where competence and likability are mixed at different levels, an evaluator will be more lenient with an individual who they see more like themselves, more likability. Inversely the evaluator will be more repulsed by someone who is less similar, less likable, but may have more competence, therefor might be more suitable. They concluded that personal feelings play a much more critical role in personnel decisions than actual competence, especially when the subordinate is vastly similar, or dissimilar, to the supervisor in charge of the selection (Casciaro & Lobo, 2005). These effects seem to be stronger if the superior making the selection decision was once in a position like that of the subordinate, following a similar career path (Judd & James-Hawkins, 2005). If the superior was rating someone who was from a different career path and was also demographically very different, this person would be more likely to be viewed as neither warm nor competent (Judd & James-Hawkins, 2005).

In a study in 1984 regarding superior-subordinate dyads, this effect of homophily and the repulsion effect was investigated. O'Reilly et al (1984) found an interaction between superior's ratings of performance and the demographics that they share with the subordinate being rated. After considering the demographics and characteristics of both the superior and subordinate, they found that there was a strong correlation with higher performance ratings when the superior had similar gender, age, race, education, and job tenure to those being evaluated. The strongest dissimilarity, repulsion effects were about gender and race, and with increased dissimilarity between subordinate and superior, lower effectiveness ratings were associated with the subordinates (O'Reilly et al, 1984).

Researchers use the term interpersonal attractiveness to explain how superior often place subordinates who are like themselves in their “in group” (Tan & Singh, 1995). They found that individuals in this “in-group” are viewed to have stronger interpersonal attractiveness and the performance ratings of the subordinates in the “in group” are significantly higher, when compared to others. Additionally, the quality of the interpersonal attraction and the resulting “in group” determination is based solely on assumptions of similarity on non-performance characteristics, rather than any performance-based criteria (Tan & Singh, 1995). This effect has been especially significant in mixed gender superior subordinate dyads, where performance evaluations are especially low for subordinates who were overall less liked than those in same-gender dyads (Varma & Stroh, 2001). This gender prejudice stems from a history of women being judged and associated with a more “warm” but less competent stereotype (Judd & James-Hawkins, 2005). Women are much less likely to be placed in the “in group” by their male supervisors, and these male supervisors tend to have a much higher homophily effect than their senior female counterparts (Varma & Stroh, 2001). The effects of similarity and likability seems to only get worse as adults mature, especially among more senior male supervisors (Tan & Singh,1995). The effect of similarity and likability seems to be much stronger for the male same-sex dyads than the female dyads, especially when age is taken into effect. Women tend to work better in more diverse environments and are only biased by homophily with respect to the attitudes and experiences of their subordinates (Varma & Stroh, 2001).

2. Military Literature

There is no research done by military research organizations, such as RAND or CNA, on the Navy Promotion board processes and its effectiveness for choosing the best and brightest officers to lead the future of our military. In fact, we only found two recent theses that cover military board processes similar to the SWO promotion board, and their relative deficiencies. Of the two articles, the Army Colonel selection process is analyzed, as well as, the command screening board for the Marine Corps, which is the most like our Navy’s unrestricted line promotion board at the O-5 level.

These two branches use a process much like the Navy O-5 promotion board, in which an individual is assessed for selection based on past performance (through fitness or evaluation reports) at an annual selection board comprised of a diverse set of officers from different backgrounds who vote on the selection of the potentials for promotion. In these two research papers the Army and Marine selection systems was analyzed and several deficiencies were identified relating to board input, the process, and the board membership.

Input refers to the documents that are presented to the board members for evaluation to submit their vote for promotion during the board. Norris also concluded that evaluation of an officer's past performance was not the most accurate tool to provide board members with pertinent information for future performance of an officer. It is inadequate as a tool for measuring experience and potential, when any future job that the promoted officer will be serving in will be significantly different past positions (Norris, 2013).

Another deficiency found was with the composition of the board members. Because of the diverse background of the board members, a member with a unique background from the officer they are voting on may introduce biases to the voting (Norris, 2013). A member who has very different experience from the officer they are evaluating may not be able to objectively evaluate a candidate's file for selection. An officer who originated from a different field of the Army may not fully understanding the requirements and values needed for promotion in that candidate's specific field (Norris, 2013). This bias can also stem from the repulsion effect, mentioned in some of the civilian literature, where an officer from a different background may feel less attraction towards an officer from a different background, especially if the officer is demographically different from the candidate up for promotion.

A more recent Navy Postgraduate School thesis analyzing the effectiveness of a Marine Corps command screening board process was conducted by Tarsiuk (2019). Like the analysis on the Army's selection board process, Tarsiuk found deficiencies in the subjectivity of the selection process, but she also found that board member composition strongly correlated with which candidates were selected for command, differing annually as the composition of the board members changed. She used similar theories such as homophily and interpersonal attraction to explain why some of these biases may be present in the Marine Corps selection system (Tarsiuk, 2019).

She surveyed board members to ask what their top three criteria for selection of an officer to command would be. Due to the vast differences of answers between respondents, it is evident that different values and experiences of the board members related to different priorities and qualities that they look for in selecting future leaders.

In a quantitative analysis very similar to the one we conduct, she found that obvious variables such as performance evaluations, fitness, and awards have a high correlation to selection probability. However, she also found other non-performance related characteristics that were associated with different probabilities of selection. Tarsiuk concluded that junior officers were selected a lower rate than the rank above them, as well as non-white officers were also selected at a lower rate than the white officers in the sample. Both groups were selected at a lower rate, vice being overrepresented in the sample than the comparison group (Tarsiuk, 2019).

Regarding board composition which changes annually, Tarsiuk found that when it comes to selecting Primaries, the board is much more consistent compared to when they select Alternates. Most of the variables that seem to matter for Primaries are not like those who are selected for Alternates across different years. Also, as the board composition changes from year to year, the results of selection are highly dependent on the gender, race, deployment experience, and physical fitness test (PFT) when the characteristics of the candidates are like those of the board members (Tarsiuk, 2019). This is also very similar to the findings from civilian literature that support homophily and likability biases involved in supervisor selections. One last significant finding was the representation of women and minorities in the board member composition (Tarsiuk, 2019). On average, of the board's that Tarsiuk analyzed, boards had only 1-3 board members who represented minority or gender categories. We believe that this is also a problem with the composition of the Navy board process and will need to be further addressed in future research on the Navy's board process.

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IV. REVIEW OF CURRENT O-5 PROMOTION AND SCREENING FOR COMMAND POLICIES

A. PROMOTION BOARD SELECTION PROCESS AND CRITERIA

Every fiscal year all officers who are eligible for promotion undergo the promotion board process as required by Title 10 statute. These boards are in place to determine if an officer meets the criteria to promote to the next pay grade. As governed by SECNAVINST 1420.1 (series), the following is the process for Active-Duty Officer regular statutory promotion boards. This is intended to only be an overview of the promotion board processed derived from a PowerPoint brief created by PERS-80 from the Naval Personnel Command website (PERS-80, 2018).

1. NAVADMIN

As mention in the PERS-80 brief, the board process begins with a NAVADMIN which is released announcing the convening of promotion selection boards. The brief states that the NAVADMIN provides the following,

- Announces next Fiscal Year's zones for each competitive category of [naval] officers –Always released in December –Not less than 30 days prior to first board –Based on the Promotion Plan produced by CNP N13
- Individual Eligibility –Based on your Date of Rank and Lineal Number, which is available on BUPERS ONLINE, which contains the Naval Register. (PERS-80, 2018, p 3)

2. Selection Board Precept

Following the NAVADMIN, the promotion board precept is released and signed by the secretary of the navy (SECNAV) (PERS-80, 2018, p 13). As stated in the brief, one precept is released each fiscal year covering all officer O-6 and junior statutory boards. PERS-80 provides the following guidance with respect to the selection board precept,

- Signed by SECNAV
- ONE issued each FY and covers all O-6 and below statutory boards convened in that FY
- Promulgates general guidance on the function and procedures of all statutory selection boards

- Contains the required oaths for the board members and recorders to ensure strict confidentiality of proceedings
- Addresses equal opportunity and diversity guidance
- Addresses processing and routing of promotion selection board reports
- References SECNAV approved community briefs & competency/skill information. (PERS-80, 2018, p 13).

PERS-80 also states that the precept provides the following requirements for the statutory board composition for URL officers,

- 5 Aviators (13X0 with at least one pilot 1310 and one NFO 1320)
- 4 Surface (1110)
- 3 Submarine (1120)
- 1 Special Warfare (1130)
- 1 Special Operation (1140)
- Included in the above minimum requirements are:
- 1 Joint Rep (JQO) and one alternate (approved by CJCS)
- 3 Acquisition Professional (APM), 1 each SWO/AVIAT/SUBS for O-6/O-7 boards and 1 APM for O-5/O-4 boards
- Minority/Female Reps. (PERS-80, 2018, p 8).

See appendix A for sample approved community brief and approved officer competency/skill information and FY2020 board membership list by designator and rank.

3. Promotion Convening Order

Following the promotion board precept, the promotion selection board convening order is signed and released by SECNAV (PERS-80, 2018, p 14). PERS-80 brief states that the convening order is,

- Issued for EACH board and provides the authority to convene the board
- Provides the date, time, and location of the selection board along with official list of membership, recorders, and admin support for that board
- Sets the “best and fully qualified” selection standard along with the authorized percentage to select for each competitive category
- Defines skill requirements to be considered by the board for each competitive category
- Defines additional considerations by the board for each competitive category
- Sets the statutory objectives for Joint and Acquisition Corps. (PERS-80, 2018, p 14).

Listed below are excerpts from the Navy's FY2020 convening order for promotion to O-5 for URL officers. As stated in the convening order, the pool from which the Navy will promote officers starts with officers that are at a minimum "fully qualified" and then ideally those chosen for promotion are "best qualified". The FY2020 convening order defines these categories as follows, an officer is "fully qualified" when they can perform the duties of the next highest paygrade. However, the convening order goes into further detail:

1. **Fully Qualified**. Officers fully qualified for promotion demonstrate an appropriate level of leadership, professional skills, integrity, management acumen, grounding in business practices, and resourcefulness in difficult and challenging assignments. Their personal and professional attributes include adaptability, intelligent risk-taking, critical thinking, innovation, adherence to Navy and DoD ethical standards, physical fitness, and loyalty to the Navy core values.
2. **Best Qualified**. Among the fully qualified officers, you must recommend for promotion the best qualified officers within their respective competitive category. Proven and sustained superior performance in command or other leadership positions in difficult and challenging assignments is a definitive measure of fitness for promotion. Furthermore, successful performance and leadership in combat conditions demonstrate exceptional promotion potential and should be given special consideration. Each board member shall apply this guidance when deliberating and voting.
3. **Skill Requirements**. The Navy must focus on the skill sets mandated by current needs and on developing the professional competencies required in our future leadership. (Woods, 2019, p 2-3).

4. Convening Day

The promotion process brief provided by PERS-80 goes on to state that on convening day board members arrive and review the precept and convening orders. The brief also states that,

- Board members arrive on board convening day and review precept/convening order
- Usually 0800 start with welcome/admin remarks
- Members and Recorders are sworn in (Oaths)
- Mandatory SECNAV brief
- Members proceed to the appropriate board room
- Members are provided training on the board software application

- Eligible [naval officer] records are distributed randomly to board members
- [Board] Members begin review and grade of above and in-zone eligible records
- [Board] Member reviews all FITREPs and other applicable items in the official record of the assigned eligible and places grade, notes, and highlights on the OSR/PSR to be viewed by all board members in the "**Tank**". (PERS-80, 2018, p 18).

As pulled from the brief, Figure 2 is a photo example of what is called the "Tank" where board members will gather to brief completed eligible officer records. As stated in the PERS-80 brief, the process in which the board convenes is as follows,

- Completed records are displayed and briefed by the reviewing member in the "Tank"
- The record is briefed along with any applicable statutory items, such as LTB or Field Code-17 (FC-17) –FC-17 is privileged or adverse information of a punitive or medical nature concerning the eligible, that MUST be briefed in the "Tank"
- NOTE: Adverse/medical information can only be briefed if it contained in the eligible's official military record, such as a FC-17
- All members vote the record via a confidence factor (100, 75, 50, 25, 0)
- Head Recorder records the vote in the Head Recorder's Notebook and calls out the number of YES votes with the overall confidence factor. (PERS-80, 2018, p 22).

The brief further notes that,

- Once all AZ [above zone] & IZ [in zone] records have been briefed a[nd] voted, a scattergram is displayed that shows a cumulative number of votes at each confidence level
- The floor is open for motions
- Tentatively select those officers that are clearly at the top
- Drop from further consideration those officers that are clearly not competitive for further consideration
- NOTE: This is an overview of typical motions made by a board membership and is not meant to represent an actual "Tank" voting session
- Those officers who remain after those tentatively selected or dropped from further consideration are considered "crunch" records and are normally re-distributed among the membership for a second review in the boardroom
- NOTE: If the first review was not done by a member of the same or similar designator, the second review MUST BE. (PERS-80, 2018, p 26).

Figure 2. Photo of Selection Board Tank. Source: PERS-80 (2018).

Figure 3. Mock Example of Promotion Board Scattergram. Source: PERS-80 (2018)

Example Motion: Tentatively select those officers 90 and above

6 eligible records remain for a second review, known as “Crunch” records

Example Motion: Drop from further consideration those officers 45 and below

7 Selects 0 Alternates 7 Fails 6 Non-Select 20 Total					
SelStat	Score	# Eligibles	Total #	Score	SelStat
Select	100	3	3	100	Select
Select	95	3	6	95	Select
Select	90	1	7	90	Select
Non-Select	85			85	Non-Select
Non-Select	80	1	1	80	Non-Select
Non-Select	75	2	3	75	Non-Select
Non-Select	70	2	5	70	Non-Select
Non-Select	65			65	Non-Select
Non-Select	60	1	6	60	Non-Select
Non-Select	55			55	Non-Select
Non-Select	50			50	Non-Select
Fail	45	1	1	45	Fail
Fail	40	1	2	40	Fail
Fail	35			35	Fail
Fail	30	1	3	30	Fail
Fail	25	1	4	25	Fail
Fail	20			20	Fail
Fail	15			15	Fail
Fail	10	1	5	10	Fail
Fail	5			5	Fail
Fail	0	2	7	0	Fail

The brief finally explains that “crunch” records are reviewed, graded, displayed, briefed and voted upon in the same process mentioned above. PERS-80 goes on to explain the process,

- If there are still authorized selections available, and there are officers who are neither tentatively selected or dropped from further consideration, then those remaining records continue to be “crunched”
- Process continues until all authorized selections are filled, or the board membership does not find any additional officers meet the selection criteria
- The Select List is verified and the board votes to confirm their selections and certify they have maintained the integrity of the selection board
- The Board Members and Recorders sign the signature pages to be forwarded with the board’s Record of Proceedings
- The Board President makes any closing remarks and adjourns the board. (PERS-80, 2018, p 31).

As previously mentioned, the above was to provide a quick overview of the active duty officer promotion board process. For further information please refer to the information provided by the Naval Personnel Command PERS-80.

V. DATA AND DESCRIPTIVE STATISTICS

This thesis examines the predictive powers of URL officer professional, educational, accession source, and demographic characteristics on promotion to the rank of Commander. We also examine the differences in career outcomes by Navy community. The data used in this thesis is derived from two sources. First, we pulled data from the Defense Manpower Data Center (DMDC); it includes data on naval officers who commissioned between the fiscal years 1999-2003. We then merged this data with the Officer Personnel Information System (OPINS) data to follow the officers annually until they separate from the Navy or until the end of fiscal year 2019. After removing Limited Duty Officers (LDOs), Chief Warrant Officers (CWOs), and only observing officers at the O-1 paygrade the data set includes 16,143 observations. The data includes individuals' educational backgrounds, various demographic information, and Navy related characteristics. Note: among the cohorts of officers, there was missing educational data.

A. VARIABLE DESCRIPTIONS

1. Dependent Variables: Retention and Performance Measures

Similar to Pitzel (2018), our research will examine officers' retention at the fifteen-year mark to capture an officers' decision to stay in the service or to separate; this information will also aid in determining predictors promotion probability for officers at the rank of O-5. Like Parcell et al. (2003) and Pitzel (2018), we examine probability of promotion to grade O-5. One measure of success Parcell et al (2003) used in their research was promotion to commander, conditional on an officer staying to seventeen years of service (YOS). For purposes of this research we measure officer promotion probability at YOS 15-17. If an officer promotes to O-5 any time during their 15-17 YOS, they are coded in a binary format as a one. Also, similarly to Pitzel (2018), our O-5 promotion outcome is conditional on an officer staying to ten YOS. Table 1 shows the definitions of the dependent variables used in our research.

Table 1. Definition of Dependent Variables. Adapted from Pitzel (2018).

Dependent Variable	Variable Definition
Fifteen_Year_Retention	=1 if Months_in_Service >=180; otherwise =0.
Promoted_O5	=1 promoted to O5 paygrade (in YOS 15-17); otherwise =0.

Both of our naval officer outcome (dependent) variables are binary. Our *Fifteen_Year_Retention* variable indicates whether an officer completes at least fifteen years of service after commissioning. Our dependent variable, *Promoted_O5*, indicates whether an officer is selected to the pay grade O-5 through the process described in Chapter IV.

2. Independent Variables

The independent variables available based on the available data are broken down by commissioning source, Navy community, entry cohort, education and finally demographics. These independent variables are in the form of binary variables (dummy variables). As described in the previous chapter, the NAVADMIN determines each year the selection Promotion criteria. For this reason, in our promotion regression models we control for officers' community and for fiscal year (cohort) to hold constant any factors that could affect one cohort or community over another. Throughout history, the Navy has made numerous policy changes with respect to talent management. It could be possible that these changes may affect differently the different cohort years and communities over time and at different times. These control variables are also included in our retention models: officers in different communities and from different fiscal year cohort might be faced with different outside options when considering whether to stay or to leave the Navy. Therefore, we include these controls in our retention regression models.

Also, as found in previous literature, marital and dependent status throughout an officers' career have been shown to be associated with officer retention (Pitzel, 2018). Given we are observing officers up to fifteen years of service, we include dependent and marital status at 10 YOS to measure their predictive effect on the officer's retention and promotion outcome at 15 YOS. Table 2 shows the definitions of the demographic variables we use in our multivariate analysis.

Table 2. Definition of Demographic Variables. Adapted from Pitzel (2018).

Independent Variable	Variable Definition
Female	=1 if Female, otherwise = 0
Male	=1 if Male, otherwise = 0
Married_10	=1 if married at 10 YOS, otherwise = 0
Not_Married_10	=1 if not married at 10 YOS, otherwise = 0
Dep_Child_10	=1 if dependent child/children at 10 YOS, otherwise = 0.
No_Dep_Child_10	=1 if no dependent child/children at 10 YOS, otherwise = 0.
White_NonHispanic	=1 if White (race) & Non-Hispanic (ethnicity), otherwise = 0
Black_NonHispanic	=1 if Black (race) & Non-Hispanic (ethnicity), otherwise = 0
Asian	=1 if Asian, otherwise = 0
Hispanic	=1 if Hispanic, otherwise = 0
Other_Unkn_Race	=1 if Race is other or not known, otherwise = 0

Line officers are only commissioned at three sources; the Naval Academy, Naval Reserve Officer Training Corps, and Officer Candidate School. The Naval Academy is the Navy's own 4-year educational institution. Naval Reserve Officers Training Corps (NROTC) commissions students after completing four years of naval training while attending one of the 168 partnered educational institutions. Individuals who receive a degree, separate from the Navy, but then wish to join as an officer post-graduation, may commission through Officer Candidate School. Other commissioning sources that produce staff officers or direct commissions represent a very small portion of commissioned officers and therefore are grouped under one variable. We recognize that there are other commissioning sources such as direct commissioning which we group into one variable, similarly to Lehmann (2019). Table 3 defines the commissioning source variables.

Table 3. Definition of Commissioning Source Variables.

Independent Variable	Variable Definition
Naval Academy	= 1 if commissioning source was the Naval Academy; otherwise = 0
NROTC	= 1 if commissioning source was NROTC; otherwise = 0
OCS_OTS_PLC	=1 if commissioned from OCS, OTS, or PLC, otherwise = 0
Direct/Other Commissioning	= 1 if commissioning source was Direct, Other, or Unknown; otherwise = 0

Adapted from Pitzel (2018) and Lehmann (2018).

The Navy officer population is broken down into various communities and designations of officers. This thesis only examines retention and promotion outcomes for officers who are unrestricted line, therefore it excludes officers in the restricted line and staff communities. Among the unrestricted line officers, they are broken down and defined in Table 4, based on designator at the time of commission or entry into the Navy.

Table 4. Definition of URL Officer Community Variables.

Independent Variable	Variable Definition
SWO	=1 if Unrestricted Line & Surface Warfare, otherwise = 0
SUB	=1 if Unrestricted Line & Submarine Warfare, otherwise = 0
Special Warfare (SPEC)	=1 if Unrestricted Line & Special Warfare, otherwise = 0
Aviator	=1 if Unrestricted Line & Aviator, otherwise = 0
Unequal_Line	=1 if Unrestricted Line & Unqualified, otherwise = 0

Adapted from Pitzel (2018) & Lehmann (2019).

Table 5 presents the definitions we used for the independent variables associated with the cohort years included in our sample. These years were chosen for analysis because the officers included in those cohort years entered the Navy in FY99-FY03 and have had enough time in their career to have the opportunity to be considered for the O-5 promotion board.

Table 5. Definition of Cohort Year. Adapted from Moss (2018).

Independent Variable	Variable Definition
Cohort FY99	= 1 if officer commissioned in FY99; else = 0
Cohort FY00	= 1 if officer commissioned in FY00; else = 0
Cohort FY01	= 1 if officer commissioned in FY01; else = 0
Cohort FY02	= 1 if officer commissioned in FY02; else = 0
Cohort FY03	= 1 if officer commissioned in FY03; else = 0

Table 6 explains several education variables included in our analysis to capture the educational background of the URL officers. The definitions of these variables are similar to those used in Maugeri (2016), as well as, Menichini & Tick (2019) who used similar data. These variables include STEM and non-STEM degrees for both undergraduate and graduate level education; they also include a category for officers with any combination of STEM and non-STEM graduate and undergraduate level education if they successfully earned both in their career up to their 17 YOS. The separate variables defining college major were all defined from the NROTC Scholarship degree list (Naval Service Training Command Officer Development 2016) and the *Manual of Navy Officer Manpower and Personnel Classifications* Volume II, Appendix D (Department of the Navy 2015).

In addition to these educational variables in Table 6, we also include the undergraduate college ranking variables associated to each officer. These variables represent the ranking of the college in which the officer attended to earn their undergraduate degree and are based on the Barron's *Profiles of American Colleges,* previously used in Maugeri (2016). These rankings are divided into 6 separate categories which refer to the college's competitiveness and we have condensed the categories as Maugeri (2016) did, leaving out the Naval Academy to avoid redundancy. In addition to the categories used in Maugeri (2016), we added an additional category for those officers in which the collegiate ranking where they earned their undergraduate degree was unknown.

The reasoning behind including these college rankings into our retention and promotion models is to test whether they can predict the officers' performance and retention as a senior URL officer. The school selectivity rankings are most likely highly correlated with intellectual ability, for which we do have measures like college GPA or SAT scores to control for. These differences may provide insight as to whether there is a difference in retention and promotion outcomes among STEM and non-STEM officers, as well as across the many differing undergraduate degrees, depending on how they are ranked.

Table 6. Definition of Education Variables.

Key Independent Variable Name	Key Independent Variable Definition
STEM Degree	= 1 if officer's undergrad college major is a STEM major; 0, otherwise
Non STEM Degree	= 1 if officer's undergrad college major is a non-STEM major; 0, otherwise
Engineering	= 1 if officer's undergrad college major is an engineering major; 0, otherwise
Mathematics	= 1 if officer's undergrad college major is a mathematics or computer science major; 0, otherwise
Physical Sciences	= 1 if officer's undergrad college major is a physical science major; 0, otherwise
Social Sciences	= 1 if officer's undergrad college major is a social science major; 0, otherwise
Humanities	= 1 if officer's undergrad college major is a humanity major; 0, otherwise
Business	= 1 if officer's undergrad college major is a business or economics major; 0, otherwise
Biology	= 1 if officer's undergrad college major is a biology major; 0, otherwise
Other Major	= 1 if officer's undergrad college major is an agriculture, education, medical, law, or communication major; 0, otherwise
STEM Graduate Education	= 1 if officer's graduate major is STEM; 0, otherwise
All STEM Education	= 1 if officer's undergraduate and graduate major is STEM; 0, otherwise
STEM Undergrad & Non-STEM Grad	= 1 if officer's undergraduate major is STEM and graduate education is Non-STEM; 0, otherwise
Non-STEM Undergrad & STEM Grad	= 1 if officer's undergraduate major is non-STEM and graduate education is Non-STEM; 0, otherwise

Key Independent Variable Name	Key Independent Variable Definition
All Non-STEM Education	= 1 if officer's undergraduate major is non-STEM and graduate education is Non-STEM; 0, otherwise
Graduate Education	= 1 if officer's educational level is post-graduate, master's degree, or PHD; 0, otherwise
University Competitiveness High	=1 if school rated as Most Competitive, 0 otherwise
University Competitiveness Medium	=1 if school rated as Highly Competitive or Very Competitive, 0 otherwise
University Competitiveness Low	=1 if school rated as Competitive, Less Competitive, or Non-competitive, 0 otherwise
University Competitiveness UNKNOWN	=1 if school rating is unknown or missing, 0 otherwise

Adapted from Menichini and Tick (2019) and Maugeri (2016).

B. SUMMARY STATISTICS AND SURVIVAL ANALYSIS

1. Summary Statistics

The entire data set available to us had 16,145 observations of naval officers, of which, just over 40 percent of the sample successfully retain past 15 YOS, while only 26 percent successfully promote to the rank of Commander. The composition of the full data set shows that we have a typical naval officer population here, with eighty percent males, about three quarters White, with about a quarter of them commissioned from the Naval Academy, and another quarter from the NROTC. The mean and standard deviations for the dependent variables used in our analysis, and well and for the independent variables we use, are presented in detail in Table 7, including when the observations were restricted to control for missing data in each broad category.

For the officers with complete educational records, our sample shows about half of the naval officers having a technical, STEM college background, and thirteen percent of them have an all STEM educational background, with technical degrees both, at the college and graduate level. Furthermore, forty six percent of the officers in the full sample have a graduate degree obtained by their seventeen year of service. One fifth of the commissioned officers in our sample have degrees from an institution that is ranked as highly selective.

Table 7. Overall Summary Statistics

Summary Statistics	Mean	Standard Deviation	Observations
Dependent Variables			
Fifteen Year Retention	0.409	0.492	16,145
Promoted O-5	0.266	0.442	16,145
Independent Variables			
Demographics			
Female	0.184	0.378	16,145
Male	0.815	0.378	16,145
Married_10	0.803	0.398	8,902
Not_Married_10	0.197	0.398	8,902
Dep_Child_10	0.596	0.491	8,902
No_Dep_Child_10	0.404	0.491	8,902
White_NonHispanic	0.752	0.432	16,145
Black_NonHispanic	0.071	0.257	16,145
Asian	0.051	0.219	16,145
Hispanic	0.094	0.292	16,145
Other_Unkn_Race	0.032	0.176	16,145
Commissioning Source			
Naval Academy	0.24	0.427	16,145
NROTC	0.265	0.441	16,145
OCS_OTS_PLC	0.324	0.468	16,145
Direct/Other Commissioning	0.149	0.525	16,145
URL Community Designator			
SWO	0.233	0.423	16,145
SUB	0.098	0.297	16,145
Special Warfare (SPEC)	0.017	0.128	16,145
Aviator	0.285	0.451	16,145
Unqual_Line	0.125	0.461	16,145
Cohort Year			
Cohort FY99	0.183	0.387	16,145
Cohort FY00	0.208	0.406	16,145
Cohort FY01	0.211	0.408	16,145
Cohort FY02	0.206	0.404	16,145
Cohort FY03	0.192	0.394	16,145

Education Variables			
STEM Degree	0.522	0.499	13,086
Non STEM Degree	0.488	0.499	13,086
Engineering	0.228	0.419	16,145
Mathematics	0.019	0.136	16,145
Physical Sciences	0.076	0.265	16,145
Social Sciences	0.172	0.377	16,145
Humanities	0.028	0.166	16,145
Business	0.113	0.317	16,145
Biology	0.027	0.162	16,145
Other Major/Unknown	0.299	0.457	16,145
Graduate Education	0.463	0.499	16,145
STEM Graduate Education	0.176	0.381	13,086
All STEM Education	0.132	0.338	13,086
STEM Undergrad & Non STEM Grad	0.1	0.3	13,086
Non STEM Undergrad & STEM Grad	0.044	0.205	13,086
All Non STEM Education	0.188	0.391	13,086
University Competitiveness High	0.2	0.4.	16,145
University Competitiveness Medium	0.256	0.436	16,145
University Competitiveness Low	0.037	0.187	16,145
University Competitiveness UNKNOWN	0.235	0.424	16,145

For all STEM education variables, the number of observations was reduced to 13,086 from 16,145. This is due to missing education information for 3,059 officers in the sample. Additionally, demographic variables for marital and dependent status were reduced to 8,902 observations to account for these variables being assessed conditionally on an officer completing 10 YOS; 7, 243 observations were not included due to an officer leaving the Navy prior to reaching 10 YOS, or the officers marital or dependent information was missing.

2. Survival Analysis

Instead of presenting mean comparisons in the retention at 10 years, and 15 years of service, we present instead a survival analysis which may allow us to gain more information on the retention patterns in our data if we compare retention means over time.

To conduct this type of investigation we use survival descriptive analysis using Cox proportional hazard models. This type of descriptive statistic illustrates, graphically, the dynamic patterns of officers' mean retention rates over time, and not just as a snap shot at a given point in their career. Specifically, the survival descriptive analysis we use here shows the dynamic patterns of the mean probability of officers' retention in a given month, conditional on them being observed in service in the previous month. Figures 4 through 8, are the curves representing survival functions for different categories of officers. Officers in our data are observed from entry until 256 months of service. We use the full sample of our data, with officers being observed monthly from the commissioning date until the last month of FY2019, or until the month they separate, whichever happens first.

We present comparisons of survival profiles by gender, race, commissioning source, naval community, and educational background, to gain additional understanding of the survival patterns of different categories of naval officers in our data.

Figure 4 shows that the mean survival rates profiles for both genders are maintained relatively high until the 60th month (5th year of service) after which retention falls drastically, with a sharp decline after month 84th (year 7), and a somewhat gentler decline after the 180th month (15th year). However, not surprisingly, female officers show lower average survival rates than those of their male counterparts, with the gap wider after the 5-year mark, near the end of the officers' MSR.

Figure 4. Naval Officer Survival Rates, by Gender (1999-2019)

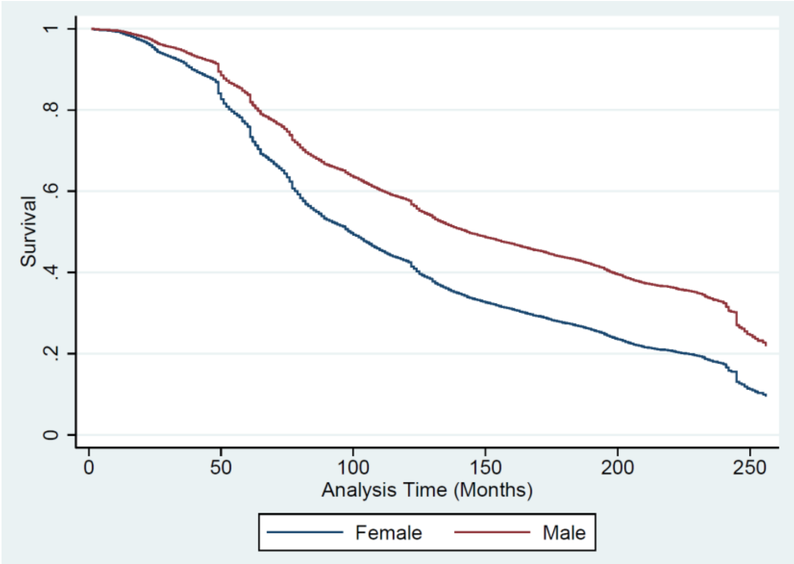


Figure 5 shows race/ethnicity differences in the survival rates of naval officers in our sample. Figure 5 shows that the mean survival rates profiles for all categories are like the profiles of gender, maintained relatively high until after 5-7 YOS, after which retention falls somewhat gentler decline until 10 YOS, where we see another sharp decline in the survival profile for all categories, especially non-white. White officers show higher average survival rates than those of their counterparts, with the gap wider after 10 YOS.

Figure 5. Naval Officer Survival Curve, by Race/Ethnicity (1999-2019)

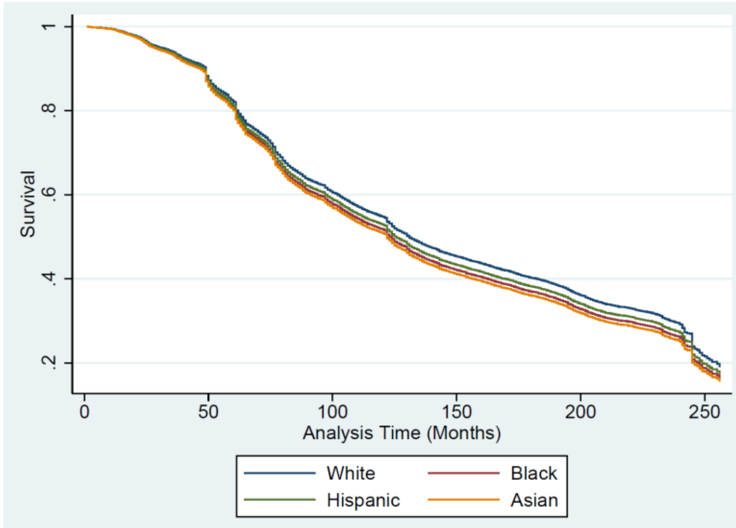


Figure 6 shows the survival profiles by commissioning source. The different categories seem to trend very closely until the end of the MSR for all officers, however after 5 YOS the gap starts to widen between ROTC and other commissioning sources compared to that of the USNA and OCS officers. Following their MSR OCS and USNA officers seem to trend together slightly higher than their counterparts. The next slight drop that is evident for all categories is consistent with the findings in the previous figures were there is a sharp decline at 10 YOS.

Figure 6. URL Survival Curve by Commissioning Source

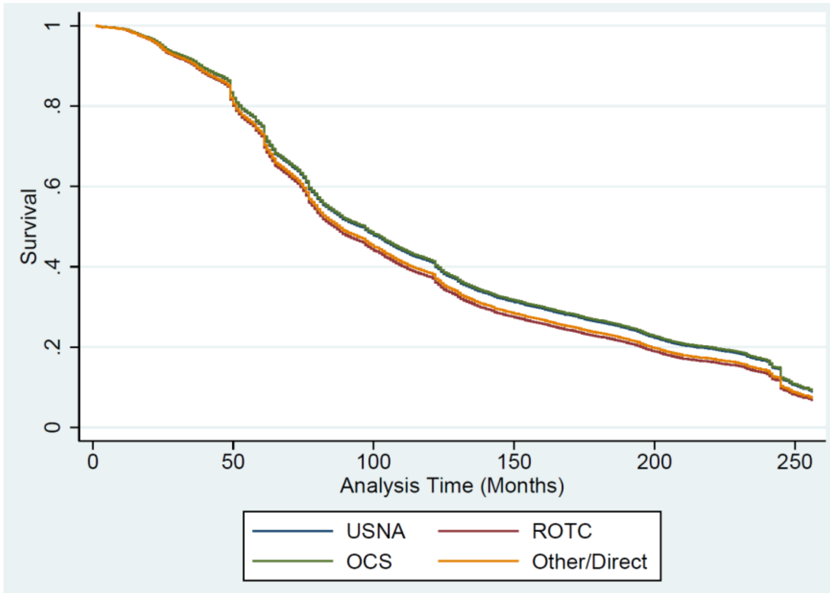


Figure 7 shows a very interesting picture of the survival profiles by community designation. The overall survival profile is consistent with the pattern seen in the previous figures. However, the aviation and SPECWAR officers have a much lower average survival profile than when compared to the SUB and SWO categories. However, the SPECWAR officers comprise 1.7 percent of the sample compared to other significantly represented categories of URL officers. Even though both sets of commissioning sources follow a similar trend across months, the gap between them is quite significant and consistent over the time of their career.

Figure 7. URL Survival Curve by Community

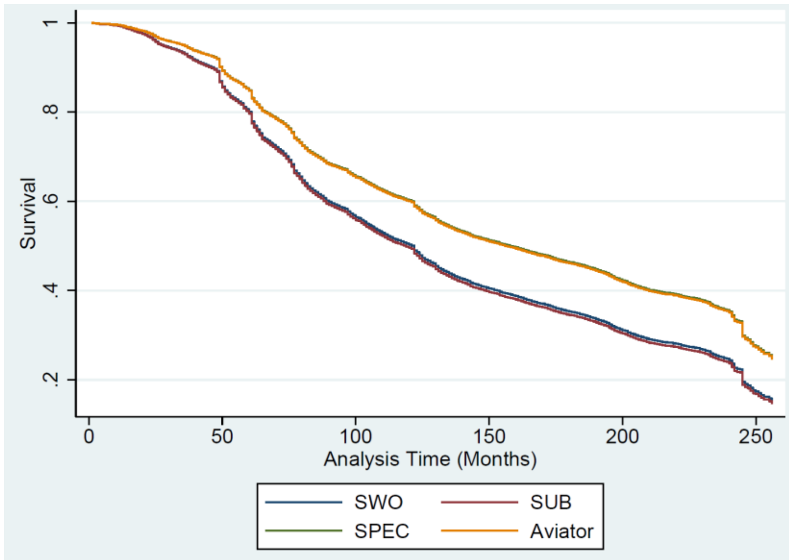
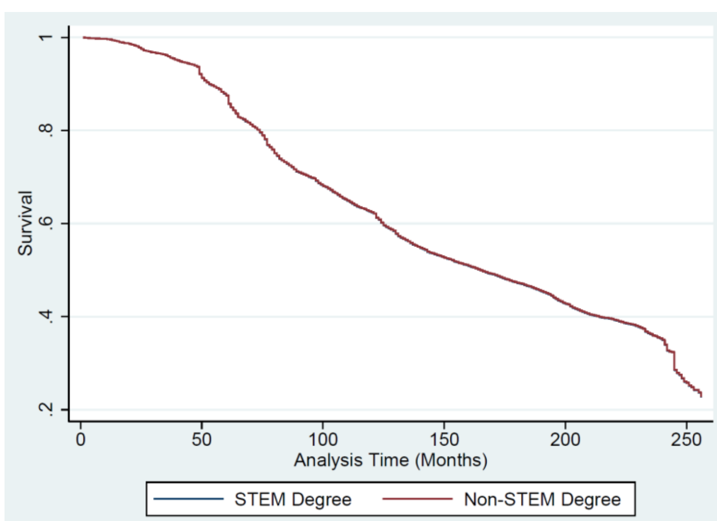


Figure 8 is very interesting, especially considering the conflicting research that we have discussed involving the effect of STEM degrees on an officers' career progression. Figure 8 provides a visual of what Menichini and Tick (2019) may have found, an unclear picture of any difference between earning a STEM degree and a non-STEM degree on naval officer retention.

Figure 8. URL Survival Curve by STEM Degree



VI. ANALYSIS AND FINDINGS

This chapter will present the multivariate regression analysis of the data previously described and summarized in Chapter V, separated by retention and promotion models, for URL officers. While the survival analysis described in the previous chapter helps to visualize the change over time in the retention probabilities in the URL communities, this chapter will go further, to try to explain some of the patterns presented. Specifically, the multivariate models analyze the data further to determine which characteristics among education, demographics, accession source, and designator have the strongest predictive effects on promotion to the rank of O-5 and retention at 15 YOS.

The outcome variables of *Fifteen Year Retention* and *Promoted O*-5 are binary and will be measured through a Linear Probability Model (LPM) through the Ordinary Least Squares (OLS) technique, like Moss (2018) previously discussed. Using the various independent variables discussed in the previous chapter, the OLS coefficient estimates in the specified LPMs represent the change in the probability of success (either promotion or retention) for a one unit change in each independent variable, while holding the other variables in the model fixed (Wooldridge 2015, 225). When the independent variables are also binary this estimate will represent the effect of the binary variable being equal to 1 on the probability of successful retention or promotion, compared to when the binary independent variables are equal to zero. We chose to use these models to simplify interpretations of coefficients. This chapter will explain the LPM models and the OLS estimates for the retention and promotion models and thoroughly explain the results.

A. FIFTEEN-YEAR RETENTION MODEL

The fifteen-year retention model is specified using the binary dependent variable where *Fifteen Year Retention* =1 if the officer has completed 15 YOS (or greater than 180 months) and =0 if otherwise. The *Fifteen Year Retention* model controls for demographics, professional and educational background differences, as explained in the previous chapter. The reference group is very similar to that in Maugeri’s (2016) analysis of retention, consisting of *White Male, No Dependent Children, Not Married, Cohort 99, SWO,* and

OCS. For the second specification of the fifteen-year retention model, the reference group additionally includes officers without a STEM undergraduate degree. For specification three, the reference group additionally includes officers with non-STEM education at both the undergraduate and graduate levels; here, the reference group includes officers with a social science undergraduate degree. For specification four, the reference group includes officers with a social science undergraduate degree, while the fifth specification has as the reference group also officers with undergraduate degrees from a medium ranked university. The sixth and last model specification includes the additional references of officers with a non-STEM degree and education from a medium ranked university.

The *Fifteen Year Retention* models are only estimated for officers who are in the URL community at entry and have successfully completed 10 YOS. Based on these exclusion restrictions, our sample has 8,565 observations. The summary statistics are presented in the Appendix F.

1. Pr (*Fifteen Year Retention* =1 | X) = $\beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + μ

2. Pr (*Fifteen Year Retention* =1 | X) = $\beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (*STEM Degree*) + μ

3. Pr (*Fifteen Year Retention* =1 | X) = $\beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (STEM Education Combination) + μ

4. Pr (*Fifteen Year Retention* =1 | X) = $\beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (Education Type) + μ

5. Pr (*Fifteen Year Retention* =1 | X) = $\beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (College Ranking) + μ

6. $\Pr(\textit{Fifteen Year Retention} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (*STEM Degree*) + β_6 (College Ranking) + μ

The first column in table 7 presents the estimates for the baseline model. This model provides the coefficient estimates while controlling for baseline variables, which include demographics, commissioning source, officer cohorts, and officer communities limited to unrestricted line officers. The coefficient estimates shown in the model are compared to the control group. Also, of note, the models are estimated on slight variations of sample selection criteria. The sample for each model is restricted to unrestricted line officers (SWO, SUB, SPEC, Aviator) from the cohorts listed, retained to at least ten years of commissioned service. Retention model estimates, separated by each community can be found in the appendices. These individual models may provide further insight into the differences in estimated predicted probabilities of retention among minorities and females due to their smaller representation depending on community or designator.

For the second specification, as shown in Table 7, we control for whether an officer has a STEM degree. In this specification, holding demographics, race, commissioning source, community, and officer cohort constant, we find that, on average, an unrestricted line officer with a STEM undergraduate degree, given he or she retained to at least ten years of service, is 2.8 percentage points more likely to retain to fifteen years of service than the control group of officers with Non-STEM degrees. These results are consistent with the findings for the 10 Year Retention estimated in Maugeri (2016), where officers with a STEM undergraduate degree are more likely to retain at 10 YOS.

In the third specification, we chose to restrict the sample to only officers with graduate education. Previous literature has shown (due to various reasons), that graduate education is positively associated with officer retention. However, we wanted to further tease out the predictability of STEM education at both the undergraduate and graduate levels. The additional variables added to the model in column three include, officers with STEM undergraduate and graduate degrees, officers with STEM undergraduate degrees and non-STEM graduate degrees, and officers with non-STEM undergraduate degrees and

STEM graduate degrees. Of note, only 578 officers (4 percent) from the data have a non-STEM undergraduate degree and a STEM graduate degree. The comparison group for this model includes the control group, and additionally an officer who has both non-STEM undergraduate and graduate education (2,457 officers, 19 percent). In this model, on average, holding other factors constant, officers with a non-STEM undergraduate degree and a STEM graduate degree are 8.1 percentage points less likely to retain when compared to officers with non-STEM undergraduate and graduate education.

In our fourth specification of the retention model we chose to examine officer education in more detail, by major, instead of the aggregated STEM, Non-STEM categories, to test if specific majors predict retention outcomes any differently. Of note, the sample in this model is limited to describing an officer's educational major at the undergraduate level. In this model we find that on average, holding other factors constant, an officer with an engineering degree is 4.6 percentage points more likely to retain to fifteen years of service compared to an officer with a social science degree. The academic majors in this model were defined based on how Menichini and Tick (2019) defined each major given the dataset.

Like Maugeri (2016) and Menichini & Tick (2019), our fifth model specification included variables for undergraduate collegiate ranking. The sample was also limited to officers with university information. The comparison group for this model is officers who obtained an undergraduate degree from a medium competitive or ranked university based on Barron's *Profiles of American Colleges* (Barron, 1978). Our results indicate that on average, holding other factors constant, an officer who obtained an undergraduate degree from a high-ranking institution, is 5.1 percentage points more likely to retain to fifteen years of service compared to an officer who obtained a degree from a medium ranked university.

The last retention model specification presented in our table displays estimates for not only university competitiveness, but also whether an officer has a STEM degree. The results indicate that, on average, an officer with a STEM degree is still 2.5 percentage points more likely to retain to fifteen years of service when compared to an officer without a STEM degree, even when accounting for the rank of an officer's undergraduate university. The same can also be said for an officer whose undergraduate university was considered a high-ranking university when compared to a medium ranked university.

Previously, we discussed the estimates of the different controls for the officers' education background, there are some notable estimates for the other independent variables that predict retention outcomes. When our retention model is not conditional on whether an officer has a graduate degree, the rest of the models show that on average when holding other factors constant, female officers are less likely to retain to the fifteen mark when compared to their male counterparts. This is consistent with previous literature and at different retention levels. Whether or not an officer is married also appears to be associated with retention. Given an officer's marital status at their ten years of service mark, on average, officers that are married are more likely to retain to fifteen years of service than their unmarried counterparts holding other factors constant. Also, conditional on retaining to ten years of service in the URL community, an officer who commissioned through ROTC or USNA is more likely to retain to fifteen years of service than officers commissioned through OCS. Lastly, officers in the more recent cohorts (FY02-03), aviation officers, and special warfare officers, are on average less likely to retain to fifteen years of service when compared to officer cohort FY99 and surface warfare officers.

Our results appear to align with previous retention literature from Maugeri (2016) and Pitzel (2018) whether the retention outcomes were estimated at 10, or at 15 YOS. Given the conditions mentioned, there is mixed evidence in the role STEM degrees play with respect to retention to fifteen years of service; especially when the sample with limited to officers with graduate degrees.

Table 8. Fifteen-Year Retention Model

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Female respondent	-0.056^{*}	-0.059^{*}	-0.045	-0.045	-0.054^{*}	-0.058^{*}
	(0.024)	(0.024)	(0.027)	(0.024)	(0.024)	(0.024)
Married at 10 YOS	0.072^{***}	0.063^{**}	0.046^{*}	0.068^{***}	0.072^{***}	0.064^{**}
	(0.019)	(0.019)	(0.021)	(0.019)	(0.019)	(0.019)
Dependents at 10 YOS	-0.001	0.005	-0.023	0.000	-0.001	0.008
	(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)
Black Non-Hispanic	-0.039	-0.045	-0.029	-0.042	-0.038	-0.036
	(0.025)	(0.025)	(0.028)	(0.025)	(0.025)	(0.025)
Asian	0.030	0.033	0.015	0.024	0.025	0.032
	(0.030)	(0.030)	(0.032)	(0.030)	(0.029)	(0.029)
Hispanic	0.034	0.041	0.038	0.035	0.036	0.040
	(0.023)	(0.022)	(0.023)	(0.023)	(0.023)	(0.023)
Race Unknown	-0.036	-0.009	0.007	-0.038	-0.043	-0.015
	(0.035)	(0.035)	(0.038)	(0.035)	(0.034)	(0.035)
ROTC Graduate	0.135^{***}	0.107^{***}	0.107^{***}	0.113^{***}	0.096^{***}	0.092^{***}
	(0.014)	(0.015)	(0.016)	(0.015)	(0.015)	(0.016)
Naval Academy Graduate	0.119^{***}	0.089^{***}	0.092^{***}	0.092^{***}	0.100^{***}	0.100^{***}
	(0.017)	(0.018)	(0.020)	(0.018)	(0.018)	(0.019)
Other/Direct Commissioning Source	0.092^{***}	0.093^{***}	0.057^{*}	0.096^{***}	0.097^{***}	0.091^{***}
	(0.021)	(0.022)	(0.024)	(0.021)	(0.021)	(0.022)
Cohort_FY00	-0.016	-0.027	-0.008	-0.012	-0.017	-0.026
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Cohort_FY01	-0.019	-0.022	-0.016	-0.011	-0.012	-0.020
	(0.020)	(0.020)	(0.021)	(0.020)	(0.020)	(0.020)
Cohort_FY02	-0.071^{***}	-0.079^{***}	-0.065^{**}	-0.067^{***}	-0.062^{**}	-0.077^{***}
	(0.020)	(0.020)	(0.021)	(0.020)	(0.020)	(0.020)
Cohort_FY03	-0.042^{*}	-0.054^{**}	-0.062^{**}	-0.042^{*}	-0.034	-0.053^{**}
	(0.020)	(0.020)	(0.022)	(0.020)	(0.020)	(0.020)

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Submarine Officer	0.034	0.011	0.038	0.020	0.029	0.008
	(0.019)	(0.020)	(0.021)	(0.020)	(0.019)	(0.020)
Special Warfare Officer	-0.140***	-0.153***	-0.063	-0.132***	-0.138***	-0.153***
	(0.039)	(0.039)	(0.053)	(0.039)	(0.039)	(0.039)
Aviation Officer	-0.055***	-0.058***	0.007	-0.052***	-0.051***	-0.060***
	(0.014)	(0.014)	(0.016)	(0.014)	(0.014)	(0.014)
STEM Degree		0.028*				0.025*
		(0.012)				(0.013)
All STEM Education			0.005			
			(0.018)			
STEM BS & Non-STEM Grad Ed			0.006			
			(0.016)			
Non-STEM BS & STEM Graduate Degree			-0.081**			
			(0.027)			
Biology Degree				-0.003		
				(0.034)		
Physical Sciences Degree				-0.017		
				(0.023)		
Math/CS Degree				0.066		
				(0.035)		
Engineering Degree				0.043**		
				(0.016)		
Business/Econ Degree				0.019		
				(0.019)		
Humanities Degree				-0.040		
				(0.038)		

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Other Degree				-0.111***		
				(0.021)		
High Ranked Univ					0.051***	0.048**
					(0.015)	(0.015)
Low Ranked Univ					-0.018	-0.022
					(0.030)	(0.030)
Unknown Ranked Univ					-0.119***	0.025
					(0.023)	(0.030)
Constant	0.701***	0.731***	0.791***	0.714***	0.711***	0.721***
	(0.024)	(0.024)	(0.027)	(0.024)	(0.024)	(0.025)
Observations	5109	4763	3099	5109	5109	4763
R^2	0.033	0.030	0.031	0.045	0.044	0.033

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

B. PROMOTION TO COMMANDER

The O-5 promotion model analyzes the probability of promoting to the rank of Commander and is binary like the *Fifteen Year Retention*, where *Promoted O-5* =1 if the officer successfully promoted to the rank of Commander, between 15-17 YOS, and =0 if otherwise. The commander promotion model uses the same control group of a *White*, *Male*, *No Dependent Children, Not Married, Cohort 99, SWO,* and *OCS;* it also includes all the independent variables included in the previous model for *Fifteen Year Retention*. The additions for the reference group for each model is also the same as mentioned in the fifteen-year retention model. The outcome of *Promoted O-5* is only estimated for officers who are in the URL community at entry and have successfully completed 10 YOS. The independent variables of marital status and whether an officer has dependents are binary and measured at 10 YOS for each officer. The following are the equations for each row of Table 8, explaining which variables were used in each model of analysis:

The models estimated for *Promoted O-5*

1. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + μ

2. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (*STEM Degree*) + μ

3. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (STEM Education Combination) + μ

4. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (Education Type) + μ

5. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (College Ranking) + μ

6. $\Pr(\textit{Promoted O-5} = 1 \mid X) = \beta_0 + \beta_1$ (Demographics) + β_2 (Commissioning Source) + β_3 (Cohort Year) + β_4 (Designator) + β_5 (*STEM Degree*) + β_6 (College Ranking) + μ

As previously mentioned, the outcome variable is satisfied if at some point during an officer's career between 15 to 17 years of commissioned service, they promote to the permanent grade of commander (O-5). Data is only captured for officers up to the end of fiscal year 2019. To keep each officer cohort on an equal playing field, officer cohort FY2003 was not included in our promotion models because they are only observed up to 16 years of service. This format is like Parcell et al. (2003), because they observed officer O-5 promotion given that officers survived to 17 years of commissioned service. So, each model is conditional on unrestricted line officers (SWO, SUB, SPEC, Aviator), if a naval officer from cohorts (FY99-02) retained to at least ten years of commissioned service.

The first column in Table 8 is the baseline promotion model which is the same as our baseline retention model. The coefficient estimates shown in column one is compared to the previously mentioned control group.

In columns two through six of Table 8, we add the same independent variables as we did in our retention models. With respect to officer educational background information, our most important statistically significant finding is that on average, while holding other factors constant, an unrestricted line officer who obtained an undergraduate degree from a high-ranking university is approximately 8.8 percentage points more likely to promote to the grade of commander than an URL officer with a degree from a medium ranked university. We also find that when estimating promotion to O-5, while including educational variables for specific undergraduate major type, officers with an undergraduate degree in physical sciences is on average 6.5 percentage points more likely to promote than an officer with a social science degree. Also, in the models that include officer STEM educational background information, we find no statistically significant results. Officers with STEM education at either the undergraduate level, graduate level, or both, are on average no more likely to promote than officers without STEM education.

Like our retention models, we find that officers commissioned through the USNA and ROTC are more likely to promote to O-5 compared to officers commissioned through OCS. Officers that are married at their tenth year of service are on average more likely to promote than unmarried officers. Officers from cohort FY2002 are on average less likely to promote than officers from cohort FY1999. Our promotion results are like Pitzel (2018) and Parcell et al. (2003).

Table 9. O-5 Promotion Probabilities

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Female respondent	-0.040	-0.032	-0.024	-0.023	-0.035	-0.028
	(0.030)	(0.032)	(0.037)	(0.030)	(0.030)	(0.032)
Married at 10 YOS	0.108***	0.106***	0.075*	0.103***	0.109***	0.109***
	(0.025)	(0.026)	(0.032)	(0.025)	(0.025)	(0.026)
Dependents at 10 YOS	-0.022	-0.019	-0.024	-0.021	-0.017	-0.013
	(0.020)	(0.021)	(0.025)	(0.020)	(0.020)	(0.021)

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Black Non-Hispanic	-0.069*	-0.076*	-0.061	-0.071*	-0.057	-0.055
	(0.032)	(0.033)	(0.038)	(0.032)	(0.033)	(0.033)
Asian	-0.005	-0.009	-0.003	-0.008	-0.011	-0.010
	(0.039)	(0.041)	(0.046)	(0.039)	(0.039)	(0.040)
Hispanic	-0.042	-0.048	-0.048	-0.039	-0.040	-0.050
	(0.031)	(0.032)	(0.037)	(0.030)	(0.031)	(0.032)
Race Unknown	-0.078	-0.057	-0.057	-0.082	-0.091*	-0.068
	(0.045)	(0.048)	(0.057)	(0.045)	(0.043)	(0.048)
ROTC Graduate	0.164***	0.133***	0.145***	0.139***	0.110***	0.104***
	(0.019)	(0.020)	(0.024)	(0.020)	(0.021)	(0.021)
Naval Academy Graduate	0.207***	0.176***	0.170***	0.173***	0.190***	0.191***
	(0.024)	(0.025)	(0.031)	(0.025)	(0.025)	(0.026)
Other/Direct Commissioning Source	0.040	0.040	0.021	0.046	0.042	0.034
	(0.027)	(0.029)	(0.036)	(0.027)	(0.027)	(0.029)
Cohort_FY00	-0.005	-0.007	0.002	-0.002	-0.006	-0.005
	(0.025)	(0.026)	(0.029)	(0.025)	(0.025)	(0.026)
Cohort_FY01	-0.023	-0.020	-0.033	-0.015	-0.014	-0.016
	(0.024)	(0.025)	(0.029)	(0.024)	(0.024)	(0.025)
Cohort_FY02	-0.073**	-0.080**	-0.086**	-0.069**	-0.060*	-0.075**
	(0.024)	(0.025)	(0.029)	(0.024)	(0.024)	(0.025)
Submarine Officer	0.071**	0.056*	0.066*	0.057*	0.061*	0.050
	(0.027)	(0.029)	(0.032)	(0.028)	(0.027)	(0.029)
Special Warfare Officer	-0.007	-0.017	0.105	0.009	-0.004	-0.017
	(0.047)	(0.047)	(0.062)	(0.046)	(0.046)	(0.047)
Aviation Officer	-0.020	-0.023	0.022	-0.016	-0.019	-0.027
	(0.019)	(0.020)	(0.023)	(0.019)	(0.019)	(0.020)
STEM Degree		0.026				0.021
		(0.017)				(0.017)

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
All STEM Education			0.034			
			(0.027)			
STEM BS & Non-STEM Grad Ed			0.006			
			(0.026)			
Non-STEM BS & STEM Graduate Degree			-0.041			
			(0.036)			
Biology Degree				-0.027		
				(0.045)		
Physical Sciences Degree				0.065*		
				(0.031)		
Math/CS Degree				0.006		
				(0.050)		
Engineering Degree				0.040		
				(0.022)		
Business/Econ Degree				0.044		
				(0.026)		
Humanities Degree				-0.039		
				(0.047)		
Other Degree				-0.112***		
				(0.024)		
High Ranked Univ					0.090***	0.088***
					(0.021)	(0.021)
Low Ranked Univ					-0.056	-0.060
					(0.036)	(0.036)

	(1)	(2)	(3)	(4)	(5)	(6)
	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS
Unknown Ranked Univ					-0.130***	0.035
					(0.026)	(0.043)
Constant	0.402***	0.426***	0.498***	0.409***	0.407***	0.408***
	(0.029)	(0.031)	(0.037)	(0.030)	(0.030)	(0.031)
Observations	3907	3609	2470	3907	3907	3609
R^2	0.041	0.034	0.036	0.051	0.054	0.040

Standard errors in parentheses (* p < 0.05, ** p < 0.01, *** p < 0.001). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

1. O-5 Promotion Probability of STEM Degree & College Ranking

After finding various results with respect to officer undergraduate educational information and the effects on the probability of promotion, we chose to investigate further. To determine the differences in STEM effects dependent on whether an officer obtained a degree from a high-ranking university, we created interaction variables. We created these variables by multiplying the STEM degree variable with the university ranking variables. After including all the STEM, university ranking, and interaction variables in the model for probability of promotion to O-5, Table 10 displays the results. The results are consistent with our previous model for promotion for the URL community. We find no statistically significant differences in officers with STEM degrees and the probability of promotion, even if the degree is obtained from a high-ranking university when compared to medium ranking universities. Again, an officer obtaining a degree from a high-ranking university is on average more likely to promote to O-5 when compared to an officer with an undergraduate degree from a medium ranked university, regardless of if they have earned a STEM degree.

Table 10. O-5 Promotion Probability with Interaction of STEM & College Ranking

	(1) Promoted O-5 by 17 YCS
Female respondent	-0.028 (0.032)
Married at 10 YOS	0.109*** (0.026)
Dependents at 10 YOS	-0.012 (0.021)
Black Non-Hispanic	-0.055 (0.034)
Asian	-0.011 (0.040)
Hispanic	-0.051 (0.032)
Race Unknown	-0.065 (0.048)
ROTC Graduate	0.104*** (0.021)
Naval Academy Graduate	0.191*** (0.026)
Other/Direct Commissioning Source	0.033 (0.029)
Cohort_FY00	-0.005 (0.026)
Cohort_FY01	-0.018 (0.025)
Cohort_FY02	-0.076** (0.025)
Submarine Officer	0.051 (0.029)
Special Warfare Officer	-0.015 (0.047)
Aviation Officer	-0.028 (0.020)

	(1) Promoted O-5 by 17 YCS
STEM Degree	0.023
	(0.021)
High Ranked Univ	0.112***
	(0.029)
Low Ranked Univ	-0.072
	(0.044)
Unknown Ranked Univ	-0.034
	(0.056)
STEM*High Ranked Univ	-0.045
	(0.038)
STEM*Low Ranked Univ	0.030
	(0.072)
STEM*Unknown Ranked Univ	0.170*
	(0.085)
Constant	0.408***
	(0.032)
Observations	3609
R^2	0.042

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

2. O-5 Promotion Probability by Designator

a. SWO O-5 promotion

Parcell et al. (2003), estimated predictors of officer success at promotion at the ranks of O-3 up to O-6. In their analysis they ran probit models broken down individually by URL community. So, in similar fashion, in addition to our full models we also ran models for each URL community. We chose to leave out the SPECWAR model due to the limited sample size. However, the SPECWAR retention and promotion models can be found in the appendices. Table 11 displays our SWO promotion probabilities with other designators left out. The comparison group for the models is a *White, Male, No Dependent Children (at 10 YOS), Not Married (at 10 YOS), Cohort 99,* and *OCS.*

Column one displays the baseline model which is the same as the previous full URL models including all independent variables. In column two we include officers with a

STEM undergraduate degree. We find that, when compared to SWOs without a STEM undergraduate degree, there is no statistically significant effect on the probability of performance. Column three limits the sample to only SWOs who have obtained a graduate degree. Again, we do not find any statistically significant results with respect to the effects of combinations of STEM undergraduate and graduate degrees on the probability of promotion to O-5. Column four is our regression which includes the breakdown of surface warfare officer undergraduate educational information by college major. In this model we find that SWOs with an undergraduate degree in physical sciences have on average a 10.8 percentage point higher probability of promotion when compared to SWOs with a social science degree. However, of note, from the data there are only 129 SWOs with a physical science degree who also retained to at least 10 YOS. The last two columns of the table include undergraduate university rank. Here, consistent with our full model we find that SWOs who have an undergraduate degree from a high-ranking university are on average more likely to promote than officers with degrees from a medium ranked university. Lastly, SWOs that commission through ROTC and USNA are on average more likely to promote than OCS commissioned officers.

Table 11. SWO O-5 Promotion Probability

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Female respondent	0.003	0.018	0.034	0.019	0.013	0.026
	(0.041)	(0.042)	(0.046)	(0.041)	(0.041)	(0.043)
Married at 10 YOS	0.076	0.081	0.070	0.072	0.088*	0.087
	(0.045)	(0.046)	(0.051)	(0.045)	(0.045)	(0.046)
Dependents at 10 YOS	-0.033	-0.035	-0.049	-0.036	-0.028	-0.026
	(0.039)	(0.040)	(0.044)	(0.038)	(0.038)	(0.040)
Black Non-Hispanic	-0.014	-0.022	-0.018	-0.012	-0.005	0.000
	(0.042)	(0.043)	(0.047)	(0.042)	(0.044)	(0.045)
Asian	0.020	0.022	0.044	0.010	0.010	0.020

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
	(0.061)	(0.062)	(0.067)	(0.060)	(0.061)	(0.062)
Hispanic	-0.031	-0.024	-0.014	-0.027	-0.035	-0.030
	(0.048)	(0.049)	(0.053)	(0.048)	(0.048)	(0.050)
Race Unknown	-0.077	-0.071	-0.068	-0.072	-0.077	-0.077
	(0.076)	(0.081)	(0.090)	(0.076)	(0.074)	(0.081)
ROTC Graduate	0.238***	0.205***	0.204***	0.221***	0.179***	0.168***
	(0.031)	(0.032)	(0.035)	(0.033)	(0.034)	(0.034)
Naval Academy Graduate	0.254***	0.218***	0.188**	0.228***	0.231***	0.226***
	(0.050)	(0.051)	(0.057)	(0.051)	(0.052)	(0.053)
Other/Direct Commissioning Source	0.181*	0.171	0.170	0.152	0.155	0.162
	(0.088)	(0.089)	(0.092)	(0.086)	(0.086)	(0.088)
Cohort_FY00	-0.059	-0.053	-0.023	-0.051	-0.060	-0.053
	(0.040)	(0.042)	(0.044)	(0.040)	(0.040)	(0.042)
Cohort_FY01	-0.076	-0.066	-0.049	-0.060	-0.072	-0.068
	(0.040)	(0.041)	(0.044)	(0.040)	(0.040)	(0.041)
Cohort_FY02	-0.115**	-0.111**	-0.093*	-0.115**	-0.099*	-0.102*
	(0.041)	(0.042)	(0.045)	(0.041)	(0.041)	(0.042)
STEM Degree		0.032				0.025
		(0.030)				(0.030)
All STEM Education			0.045			
			(0.041)			
STEM BS & Non-STEM Grad Ed			0.029			
			(0.045)			
Non-STEM BS & STEM Graduate Degree			0.051			
			(0.050)			
Biology Degree				0.036		
				(0.072)		

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Physical Sciences Degree				0.108*		
				(0.053)		
Math/CS Degree				-0.039		
				(0.090)		
Engineering Degree				-0.003		
				(0.042)		
Business/Econ Degree				0.037		
				(0.041)		
Humanities Degree				0.029		
				(0.085)		
Other Degree				-0.145***		
				(0.042)		
High Ranked Univ					0.102**	0.100**
					(0.037)	(0.037)
Low Ranked Univ					-0.059	-0.066
					(0.050)	(0.050)
Unknown Ranked Univ					-0.184***	0.020
					(0.047)	(0.074)
Constant	0.422***	0.432***	0.465***	0.430***	0.423***	0.412***
	(0.045)	(0.047)	(0.053)	(0.048)	(0.046)	(0.048)
Observations	1234	1177	985	1234	1234	1177
R^2	0.061	0.052	0.052	0.076	0.081	0.060

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

b. SUB O-5 promotion probabilities

When examining only SUB officers we find less significant results. However, there are much fewer SUB officers in the sample who have retained to 10 YOS which is shown by the limited number of observations at the bottom of Table 12. For submarine officers, when compared to the same previously mentioned control group, we find no statistically significant results with respect to the effects of various educational variables on the probability of promotion to O-5. For the SUB community, we also find that Hispanic officers are on average less likely to promote than their white male counterparts. However, of note, there are only 30 Hispanic SUB officers in the sample who retain to 10 YOS. Lastly, SUB officers that are married at 10 YOS, and SUB officers who commission through ROTC and USNA are on average more likely to promote than unmarried and OCS commissioned officers.

Table 12. SUB O-5 Promotion Probabilities

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Female respondent	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married at 10 YOS	0.223**	0.197*	0.175	0.200*	0.213**	0.196*
	(0.079)	(0.081)	(0.091)	(0.080)	(0.079)	(0.082)
Dependents at 10 YOS	-0.092	-0.073	-0.081	-0.081	-0.090	-0.071
	(0.063)	(0.063)	(0.065)	(0.063)	(0.063)	(0.064)
Black Non-Hispanic	-0.064	-0.059	-0.042	-0.062	-0.065	-0.057
	(0.094)	(0.096)	(0.106)	(0.094)	(0.096)	(0.098)
Asian	0.143	0.111	0.107	0.119	0.130	0.108
	(0.112)	(0.113)	(0.116)	(0.114)	(0.111)	(0.114)
Hispanic	-0.271**	-0.309**	-0.342**	-0.260*	-0.265*	-0.311**
	(0.100)	(0.100)	(0.127)	(0.104)	(0.102)	(0.101)
Race Unknown	-0.086	-0.112	-0.050	-0.107	-0.099	-0.111
	(0.161)	(0.164)	(0.185)	(0.169)	(0.161)	(0.164)

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
ROTC Graduate	0.122*	0.095	0.073	0.106	0.097	0.093
	(0.057)	(0.059)	(0.067)	(0.059)	(0.062)	(0.063)
Naval Academy Graduate	0.241***	0.218***	0.191**	0.232***	0.222***	0.222***
	(0.058)	(0.059)	(0.066)	(0.060)	(0.062)	(0.062)
Other/Direct Commissioning Source	0.099	0.101	0.026	0.111	0.083	0.102
	(0.279)	(0.280)	(0.253)	(0.279)	(0.280)	(0.279)
Cohort_FY00	-0.080	-0.062	-0.078	-0.066	-0.070	-0.062
	(0.076)	(0.078)	(0.087)	(0.077)	(0.076)	(0.078)
Cohort_FY01	-0.048	-0.043	-0.072	-0.039	-0.040	-0.042
	(0.071)	(0.072)	(0.079)	(0.072)	(0.071)	(0.073)
Cohort_FY02	-0.049	-0.040	-0.037	-0.050	-0.038	-0.041
	(0.069)	(0.070)	(0.077)	(0.069)	(0.069)	(0.070)
Cohort_FY03	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
STEM Degree		0.044				0.043
		(0.056)				(0.056)
All STEM Education			-0.001			
			(0.078)			
STEM BS & Non-STEM Grad Ed			-0.053			
			(0.087)			
Non-STEM BS & STEM Graduate Degree			-0.113			
			(0.106)			
Biology Degree				-0.026		
				(0.174)		
Physical Sciences Degree				0.073		
				(0.080)		
Math/CS				0.045		

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Degree						
				(0.104)		
Engineering Degree				0.035		
				(0.063)		
Business/Econ Degree				0.088		
				(0.132)		
Humanities Degree				-0.118		
				(0.223)		
Other Degree				-0.104		
				(0.094)		
High Ranked Univ					0.016	0.012
					(0.062)	(0.063)
Low Ranked Univ					-0.005	-0.020
					(0.155)	(0.154)
Unknown Ranked Univ					-0.142	0.034
					(0.090)	(0.162)
Constant	0.449***	0.445***	0.593***	0.441***	0.466***	0.441***
	(0.078)	(0.088)	(0.114)	(0.089)	(0.082)	(0.090)
Observations	452	425	336	452	452	425
R^2	0.072	0.070	0.072	0.081	0.078	0.070

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

c. *Aviation O-5 promotion probabilities*

Table 13 displays O-5 promotion probabilities for aviators. In this case, an aviator is an officer that is either a pilot or naval flight officer (NFO). Like the other community's undergraduate educational background has little association to an aviator's probability of promotion. However, just like SWOs, aviators with undergraduate degrees from a high-ranking university, are on average more likely to promote to O-5 when compared to the control group and officers with an undergraduate degree from a medium ranked university. Of note with respect to the aviation community, we find that on average females and black non-Hispanic males to be less likely to promote than their white male counterparts. However, of note, there are only 190 female aviators and 109 black non-Hispanic aviators in the sample who retain to 10 YOS. Lastly, aviators that are married at 10 YOS, and aviators who commission through ROTC and USNA are on average more likely to promote than unmarried and OCS commissioned officers.

Table 13. Aviation O-5 Promotion Probabilities

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Female respondent	-0.100*	-0.106*	-0.113	-0.084	-0.101*	-0.107*
	(0.046)	(0.048)	(0.063)	(0.046)	(0.046)	(0.048)
Married at 10 YOS	0.111***	0.109**	0.050	0.109**	0.109**	0.109**
	(0.034)	(0.036)	(0.047)	(0.033)	(0.034)	(0.036)
Dependents at 10 YOS	0.004	0.007	0.022	0.004	0.005	0.010
	(0.027)	(0.028)	(0.037)	(0.027)	(0.027)	(0.028)
Black Non-Hispanic	-0.176**	-0.190**	-0.188*	-0.182**	-0.160**	-0.164**
	(0.056)	(0.058)	(0.081)	(0.055)	(0.057)	(0.059)
Asian	-0.072	-0.082	-0.101	-0.064	-0.070	-0.074
	(0.059)	(0.063)	(0.078)	(0.059)	(0.058)	(0.062)
Hispanic	-0.022	-0.036	-0.011	-0.024	-0.017	-0.036
	(0.045)	(0.047)	(0.059)	(0.045)	(0.045)	(0.047)
Race Unknown	-0.099	-0.057	-0.060	-0.105	-0.121*	-0.073
	(0.062)	(0.068)	(0.089)	(0.061)	(0.059)	(0.067)
ROTC Graduate	0.117***	0.084**	0.097*	0.089**	0.060	0.056
	(0.029)	(0.030)	(0.039)	(0.030)	(0.031)	(0.032)
Naval Academy Graduate	0.164***	0.131***	0.137**	0.122***	0.143***	0.146***
	(0.033)	(0.035)	(0.047)	(0.035)	(0.035)	(0.037)

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Other/Direct Commissioning Source	0.006	-0.000	-0.030	0.011	0.006	-0.007
	(0.030)	(0.033)	(0.042)	(0.030)	(0.030)	(0.033)
Cohort_FY00	0.060	0.049	0.051	0.057	0.055	0.050
	(0.037)	(0.039)	(0.045)	(0.037)	(0.036)	(0.039)
Cohort_FY01	0.027	0.027	0.002	0.030	0.036	0.031
	(0.035)	(0.037)	(0.046)	(0.035)	(0.034)	(0.037)
Cohort_FY02	-0.032	-0.046	-0.090*	-0.028	-0.021	-0.042
	(0.034)	(0.036)	(0.045)	(0.034)	(0.034)	(0.036)
Cohort_FY03	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
STEM Degree		0.010				0.007
		(0.024)				(0.023)
All STEM Education			0.006			
			(0.045)			
STEM BS & Non-STEM Grad Ed			-0.006			
			(0.035)			
Non-STEM BS & STEM Graduate Degree			-0.101			
			(0.064)			
Biology Degree				-0.098		
				(0.063)		
Physical Sciences Degree				0.045		
				(0.044)		
Math/CS Degree				0.005		
				(0.075)		
Engineering Degree				0.044		
				(0.031)		
Business/Econ				0.038		

Degree	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
				(0.036)		
Humanities Degree				-0.057		
				(0.060)		
Other Degree				-0.104^{**}		
				(0.032)		
High Ranked Univ					0.086^{**}	0.084^{**}
					(0.029)	(0.030)
Low Ranked Univ					-0.083	-0.083
					(0.060)	(0.061)
Unknown Ranked Univ					-0.114^{***}	0.054
					(0.033)	(0.059)
Constant	0.360^{***}	0.399^{***}	0.547^{***}	0.377^{***}	0.373^{***}	0.380^{***}
	(0.038)	(0.043)	(0.054)	(0.041)	(0.040)	(0.044)
Observations	2098	1888	1093	2098	2098	1888
R^2	0.038	0.033	0.041	0.049	0.050	0.039

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

C. SUMMARY

his chapter covered the results of our *Fifteen Year Retention* and the *Promoted O-5* models for URL officers. The findings are limited to only consider those officers that entered the Navy with a URL designation and reached 10 YOS. We estimated the models using several independent explanatory variables such as demographics, education, commissioning source, and STEM; these variables were included to measure their level of association with retention at 15 YOS and promotion to the rank of O-5. Consistently across all models, females were less likely to retain at 15 YOS when compared to male officers; additionally, officers who were married at 10 YOS were more likely to retain and promote at higher levels than their unmarried counterparts.

When we accounted for the type of undergraduate degree that an officer earned we found that an *Engineering* degree was associated with a 4.6 percentage points increase in retention probability at 15 YOS compared to someone with a social sciences degree. Our findings show that among URL officers, earning a STEM undergraduate degree is associated with higher levels of retention. Lastly, earning a STEM graduate degree is associated with lower levels of retention at 15 YOS, when accounting for those officers who obtained a non-STEM undergraduate level degree.

Further analysis included the population of officers with an undergraduate level education, we used Barron's academic college ranking to control for undergraduate college competitiveness. We found that those earning a degree from a higher-ranking college were associated with higher levels of retention at 15 YOS, when compared to those from lower ranking institutions. We found that the effect of a STEM degree still has a 2.5 percentage points more likelihood for retention even when considering Barron's college competitiveness. These results could be interpreted as positive for the Navy. The Navy's goal has always been to retain the best and brightest officers. So, if the Navy can retain officers to the ten-year mark, officers from the higher ranked universities are more likely to retain at 15 YOS.

When controlling for commissioning source, our findings were consistent with the survival profiles that we saw in the previous chapter, which provided some correlation with ROTC and USNA officers being associated with higher levels of retention at 15 YOS compared to OCS officers. The cohort year of the officers was also found to have an association with lower levels of retention for those officers in cohort 02-03, when compared to cohort 99. Lastly regarding designator, officers from the aviation and SPECWAR communities were less likely to retain at 15 YOS when compared to SWOs.

Our promotion results are similar to Pitzel (2018) and Parcell et al's (2003); females and unmarried officers were associated with lower probability of promotion than their male or married counterparts. When we investigated education and STEM variables and their association with promotion probabilities we found that a high-ranking college was again associated with an 8 percentage points increase in promotion probability than officer from a medium ranked college. While STEM results were insignificant, other education variables such as earning a physical sciences degree was associated with a 6.5 percentage point increase in the likelihood of promotion to the rank of O-5 when compared to those with a social sciences degree. These results are consistent even when we interacted the college ranking with whether an officer earned a STEM degree. College ranking remained significant and positive with relation to promotion to the rank of O-5 for URL officers, however, obtaining a STEM undergraduate degree remained insignificant, regardless of the college ranking where the STEM degree was obtained.

When we run our models individually by community we find again a positive association with officers who graduate from high-ranking universities when compared to officers with medium ranked degrees, specifically in the SWO and Aviation communities. We also find that females, and certain minorities to have lower probabilities of promotion in certain communities when compared to the control groups. The findings for commissioning source and their association with promotion probability are consistent with our results for retention at 15 YOS; USNA and ROTC officers are associated with higher levels of promotion than those commissioning through OCS. This also holds true for the SUB, SWO, and aviation communities when models are estimated individually by community.

VII. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

The Navy has recently renewed its focus on transformation of its personnel performance evaluation to insure retention and promotion processes that are less subjective and that generate metrics that are more useful for efficient personnel management. In addition, the Navy as added great emphasis on the importance of graduate education for selecting and forming Navy leaders, especially in documents like Education for Seapower.

In our thesis, using quantitative and qualitative methods, we examined how the process of Navy has been selecting and promoting its leaders, we analyzed promotion outcomes from historical personnel records, and examined whether best practices from the private sector might allow improvements in the selection of future Navy leaders to become more effective, more objective, and more integrated with the talent management efforts.

For our main research questions, to identify the professional, educational and demographic characteristics that predict O-5 promotion outcome for Navy URL officers, and to test whether their predictive powers for different categories of URL officers, such as race, ethnicity, SWO versus SUB, the main findings are summarized as follows. Similar to findings from previous related research, in this thesis we found few differences between the results of retention at 15 YOS and promotion to the rank of O-5. Unlike Menichini and Tick (2019), who found that officers with STEM degrees to not statistically differ with respect to non-STEM degree holders regarding ten-year retention, our results indicate that STEM degrees may have positive association with retention at 15 YOS. Our results were also consistent with many previous studies regarding gender and demographics resulting in females having lower retention probabilities than their male counterparts; as well as non-Hispanic Blacks being associated with lower levels of promotion to O-5 in three out of our six promotion models.

Regarding undergraduate college ranking, our findings associate higher levels promotion and retention with officers who graduate from a higher ranked college institution. This is interesting considering Parcell et al, (2003) found the strongest predictor of URL officer success, measured through successful promotion, was undergraduate college GPA. Our results are also consistent with Bowman and Mehay (2002) who found that college ranking is positively associated with worker productivity and performance. However, our results regarding college ranking are inconsistent with Maugeri (2016) and Menichini & Tick (2019) who found no significance; the difference may be due to our analysis taking place later in an officer's career compared to these studies looking at O-4 promotion and 10-year retention. Our extended analysis, which included interactions of STEM and university ranking variables also resulted in no statistically significant effects with respect to STEM degrees and university ranking. With respect to university ranking we must note the issue of selectivity bias, which we were unable to account for. In other words, officers selecting a higher-ranking undergraduate institution may be introducing selectivity bias and this may account for the higher levels of probability for retention and promotion. The selectivity bias of an officer choosing a higher ranked institution may be over inflating the estimates of this correlation.

Overall some of our findings could be indications of how well the Navy is doing at retaining its "best" officers. Since we find that officers from high ranking universities are more likely to retain and promote when compared to officers from medium ranked universities, then the Navy might be retaining its best officers. However, our findings are for officer who retain to ten-years of service. Thus, if the Navy can retain officers beyond minimum service and ten-years of service, then the Navy may be able to retain officers to at least fifteen-years of service. Various educational policies have begun to rise following the education for seapower study. Some include increased amounts of graduate education opportunities for officers. Something the Navy must consider is the amount, type of degree, and rank or competitiveness of a university that will be offered. Given that we found that there were no major differences in degree type and school rank outside of the high-ranking schools, the Navy may not need to limit officers by degree type or push officers to obtain education of only the top ranked schools.

To note, now that graduate level education is required for all senior URL officers to take command, some of the findings in this thesis might not be as insightful for predicting future O-5 promotion outcomes. If we know, moving forward, that every URL officer is now required to have advanced education to progress in their career, we can rule this characteristic out as a valid predictor of differences in promotion outcomes among URL officers, and investigate what other characteristics can help predict which officers are most likely to become the best and brightest to lead the future of our Navy.

For our secondary research questions, looking into an in-depth review of private-sector best practices for mid-, and high-level leader selection, one of the main findings is that soft-skills are becoming more and more important in selection and promotion of capable leaders in the private sector. When compared with the Navy's selection and promotion processes and procedures, we find the navy lags in using personality traits and measures of emotional intelligence metrics in its leadership selection and promotion processes, metrics that are considered increasingly important in selecting leaders in the private sector.

B. RECOMMENDATIONS

Our recommendations for the improvements in the selection and promotion process and procedures are in line with our findings, and echoed by the work in Tarsiuk (2019), one of our recommendations is that the Navy conduct a study of the URL promotion system and evaluate board members and their personnel selections during a board process. The point of focus is to analyze not only the voting board members, but to establish what members value in the Naval officers they are selecting. This analysis would provide insight into what characteristics senior leaders are prioritizing for selection to the rank of O-5.

Tarsiuk (2019) also recommended that the Marine Corps selection process include climate surveys in the board selection process and compare those findings to the FITREP assessments of the senior raters. The Navy has a similar reliance on these command climate surveys to evaluate the current leaders in our establishment and their performance. We have touched on the subjectivity of the FITREPS and the board's reliance on these documents. If we were to analyze senior raters' effectiveness through command climate surveys, a mechanism already in place, it could provide insight into these senior raters while they are currently in a leadership position. This is also important because most of these senior raters, will have sat, or will sit, on a promotion board as a voting member.

Gender, race, and age, as well as past experiences, have historically been associated with interpersonal attractiveness between supervisors and subordinates during selection periods (Lazarfield and Merton, 1954). The researchers found that when dissimilarities are present between supervisors and subordinates, there is strong negative reinforcement for selection decisions due to the repulsion effect (Lazarfield and Merton, 1954). In other words, supervisors tend to select subordinates who are “like” them and are much more likely to not select someone who is different. Officer official photos are required to be displayed at the promotion boards. We argue that these photos introduce bias into the board process because there is potential for the effects found by Lazarfield and Merton (1954) to exist if the photo is required to be displayed. Our recommendation would be to remove the officer photo requirement out of the board process. We acknowledge the Navy’s requirement for officers to be physically fit for duty and a photo is one way to capture this requirement, however we argue that physical fitness is already accounted for on a person’s Fitness report. So, the officer photo requirement only introduces the possibility for more homophily or interpersonal attraction bias by the board members as shown by research conducted by Singh and Tor (2008).

Further research on how strong this homophily effect is in the current board process may provide insight into whether selection rates differ depending on the board composition for that year. This could be done by analyzing historical promotion data across years where a picture was not included in the board process and compare those finding to more recent years where a picture is considered. This effect of similarity and likability seems to only get worse as adults mature, especially among more senior male supervisors (Tan & Singh,1995). There is a potential for this to have a strong effect on more senior officer promotion boards because of the decreased number of females and minorities considered for selection. With a smaller and smaller number of females and minorities making the selection decisions the homophily and repulsion effect may be even stronger the higher in the ranks you go.

Tarsiuk (2019) also recommended to include resumes and additional statistics in the board process to give the board members a more inclusive picture of the candidates they are considering. Furthermore, resumes and statistics are necessary but not enough in selecting commanders. The Navy must also incorporate outside analytics and analysis of officers to give the board members a more representative picture of the officers they are choosing for the future. These outside analytics could include tools like the Big Five personality traits, which are beginning to be incorporated into some military institutions to measure performance. For example, a recent Airforce study by Barron et al (2016) of pilots and their navigators was conducted using the Big Five and found high correlation among a performance rating and several personality characteristics.

Much like the civilian industry research we found by Bartram (2005) and Joseph and Newman (2010) associated with personality traits and performance, much of the correlation had to do with properly identifying the proper criteria to identify successful job performance. The more specific the criterions of performance, the more accurate that the personality traits pertinent to that job can predict future performance (Barron et al, 2016). Therefore, in future research it will be important for the Navy to better identify criterions for job performance to be able to properly evaluate job performance. More importantly be able to evaluate job performance more inclusively with personality characteristics, soft skills, and cognitive ability rather than rely on a subjective performance evaluation and a picture.

This research is limited to the data that was available to us for this thesis, as well as the restricted observable information the navy currently collects on its personnel. There is no doubt that there are other non-observed factors at play regarding the selection of an O-5 officer by the board that we simply could not account for.

We recommend Navy includes some type of personality, soft-skills assessment into Navy leadership, to assess which officers are performing better based on characteristics that are not associated with demographics, and educational background. Although these assessments (such as Big Five) are self-report in nature, they may provide understanding into how an officer perceives themselves and their leadership style; it may also provide insight into how much emotional intelligence they possess. These assessments may ultimately communicate the type of leader and how efficient/effective they may be in a future senior position.

Lastly, another area for further research should include officer performance and retention beyond the rank of O-5 and 15-year retention. Just like Parcell et al. (2003), further research could be done to observe officer O-6 promotion outcomes, FITREP outcomes, and 20-year retention. One would have to try to acquire data on older cohorts or wait until further time has past to observe these later outcomes. Fitness report outcomes have been used by previous researchers. However, most of the FITREP data the researchers acquired was only during the earlier years in an officer's career. However, we need FITREP data on officers later in an officer's career because once an officer becomes an O-3, they are ranked and given FITREP scores outside of the normal "promotable". Since FITREP scores our heavily used by the boards to determine selection to a rank, then FITREP data for these times would be helpful to determine various effects.

Ultimately, the Navy has long emphasized the importance of recruiting, retaining, and promoting the most lethal and talented sailors. The Navy has historically changed numerous policies to correctly conduct talent management. However, the Navy needs to thoroughly invest in research to see if the policies they implement are accomplishing what the Navy intends to accomplish. If the Navy wants to cultivate the most lethal and agile military force in the world during the time of great power competition then the Navy must carefully and critically examine who needs to be recruited, retained, and promoted.

APPENDIX A. SWO FIFTEEN-YEAR RETENTION

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Female respondent	-0.018	-0.016	-0.005	-0.003	-0.013	-0.012
	(0.031)	(0.031)	(0.032)	(0.031)	(0.031)	(0.031)
Married at 10 YOS	0.027	0.028	0.054	0.024	0.032	0.031
	(0.032)	(0.032)	(0.034)	(0.032)	(0.032)	(0.033)
Dependents at 10 YOS	-0.004	-0.006	-0.049	-0.002	-0.002	-0.002
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Black Non-Hispanic	-0.038	-0.041	-0.033	-0.037	-0.037	-0.027
	(0.032)	(0.032)	(0.035)	(0.032)	(0.033)	(0.033)
Asian	0.022	0.032	0.056	0.011	0.016	0.031
	(0.046)	(0.044)	(0.043)	(0.045)	(0.045)	(0.044)
Hispanic	0.040	0.051	0.054	0.044	0.038	0.048
	(0.034)	(0.032)	(0.033)	(0.033)	(0.033)	(0.032)
Race Unknown	-0.079	-0.053	-0.058	-0.075	-0.082	-0.059
	(0.062)	(0.062)	(0.073)	(0.059)	(0.060)	(0.060)
ROTC Graduate	0.160***	0.127***	0.131***	0.142***	0.123***	0.110***
	(0.023)	(0.023)	(0.024)	(0.023)	(0.024)	(0.024)
Naval Academy Graduate	0.186***	0.148***	0.127***	0.168***	0.167***	0.158***
	(0.032)	(0.032)	(0.035)	(0.033)	(0.034)	(0.034)
Other/Direct Commissioning Source	0.081	0.051	0.037	0.069	0.071	0.051
	(0.062)	(0.063)	(0.066)	(0.062)	(0.061)	(0.063)
Cohort_FY00	-0.012	-0.019	0.012	-0.006	-0.013	-0.018
	(0.034)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)
Cohort_FY01	-0.024	-0.013	0.008	-0.008	-0.020	-0.013
	(0.033)	(0.032)	(0.033)	(0.032)	(0.032)	(0.032)
Cohort_FY02	-0.061	-0.056	-0.040	-0.057	-0.052	-0.053
	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Cohort_FY03	-0.076*	-0.072*	-0.067	-0.077*	-0.074*	-0.071*
	(0.034)	(0.034)	(0.036)	(0.034)	(0.034)	(0.034)
STEM Degree		0.010				0.007
		(0.021)				(0.021)
All STEM Education			-0.012			
			(0.028)			
STEM BS & Non-STEM Grad Ed			-0.004			
			(0.030)			
Non-STEM BS & STEM Graduate Degree			-0.035			
			(0.036)			
Biology Degree				0.004		
				(0.050)		
Physical Sciences Degree				-0.028		
				(0.041)		
Math/CS Degree				0.029		
				(0.061)		
Engineering Degree				0.024		
				(0.027)		
Business/Econ Degree				-0.007		
				(0.031)		
Humanities Degree				-0.002		
				(0.062)		
Other Degree				-0.165***		
				(0.039)		

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
High Ranked Univ					0.056*	0.056*
					(0.025)	(0.025)
Low Ranked Univ					-0.021	-0.030
					(0.041)	(0.042)
Unknown Ranked Univ					-0.169***	0.081
					(0.048)	(0.053)
Constant	0.722***	0.747***	0.767***	0.741***	0.730***	0.731***
	(0.036)	(0.036)	(0.039)	(0.038)	(0.037)	(0.037)
Observations	1564	1500	1222	1564	1564	1500
R^2	0.042	0.033	0.041	0.059	0.058	0.038

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

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APPENDIX B. SUB FIFTEEN-YEAR RETENTION

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Female respondent	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married at 10 YOS	0.110*	0.103	0.049	0.104	0.112	0.109
	(0.056)	(0.058)	(0.060)	(0.055)	(0.057)	(0.059)
Dependents at 10 YOS	-0.039	-0.028	-0.016	-0.041	-0.038	-0.026
	(0.039)	(0.040)	(0.044)	(0.039)	(0.039)	(0.040)
Black Non-Hispanic	-0.048	-0.062	0.007	-0.026	-0.054	-0.069
	(0.075)	(0.077)	(0.074)	(0.072)	(0.077)	(0.078)
Asian	0.032	0.007	0.030	0.013	0.023	0.002
	(0.083)	(0.083)	(0.079)	(0.083)	(0.084)	(0.086)
Hispanic	-0.051	-0.063	-0.143	-0.035	-0.048	-0.076
	(0.081)	(0.083)	(0.105)	(0.083)	(0.082)	(0.083)
Race Unknown	0.018	0.002	0.112***	0.014	0.008	-0.002
	(0.087)	(0.088)	(0.033)	(0.088)	(0.086)	(0.087)
ROTC Graduate	0.126***	0.113**	0.139***	0.118**	0.107**	0.107**
	(0.036)	(0.037)	(0.036)	(0.037)	(0.039)	(0.038)
Naval Academy Graduate	0.084*	0.082*	0.064	0.103*	0.096*	0.100*
	(0.039)	(0.040)	(0.044)	(0.040)	(0.042)	(0.042)
Other/Direct Commissioning Source	-0.383	-0.363	-0.156	-0.351	-0.378	-0.349
	(0.227)	(0.225)	(0.259)	(0.218)	(0.223)	(0.221)
Cohort_FY00	-0.065	-0.056	-0.048	-0.060	-0.060	-0.053
	(0.063)	(0.063)	(0.066)	(0.064)	(0.063)	(0.063)
Cohort_FY01	-0.010	-0.025	-0.031	-0.008	-0.005	-0.022
	(0.056)	(0.055)	(0.060)	(0.056)	(0.056)	(0.055)
Cohort_FY02	0.003	-0.008	0.017	-0.001	0.007	-0.012
	(0.055)	(0.054)	(0.058)	(0.055)	(0.055)	(0.054)

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Cohort_FY03	-0.010	-0.025	-0.052	-0.004	-0.005	-0.028
	(0.054)	(0.054)	(0.060)	(0.054)	(0.055)	(0.054)
STEM Degree		0.072				0.069
		(0.040)				(0.040)
All STEM Education			-0.018			
			(0.052)			
STEM BS & Non-STEM Grad Ed			-0.003			
			(0.054)			
Non-STEM BS & STEM Graduate Degree			-0.124			
			(0.076)			
Biology Degree				0.020		
				(0.118)		
Physical Sciences Degree				-0.021		
				(0.055)		
Math/CS Degree				0.049		
				(0.072)		
Engineering Degree				0.060		
				(0.040)		
Business/Econ Degree				-0.111		
				(0.095)		
Humanities Degree				-0.329		
				(0.185)		
Other Degree				-0.056		
				(0.073)		
High Ranked					0.048	0.035

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Univ						
					(0.039)	(0.040)
Low Ranked Univ					0.116	0.098
					(0.097)	(0.098)
Unknown Ranked Univ					-0.004	0.179*
					(0.069)	(0.070)
Constant	0.726***	0.691***	0.832***	0.712***	0.709***	0.670***
	(0.063)	(0.072)	(0.080)	(0.070)	(0.066)	(0.072)
Observations	597	565	432	597	597	565
R^2	0.041	0.047	0.059	0.066	0.044	0.054

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

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APPENDIX C. AVIATOR FIFTEEN-YEAR RETENTION

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Female respondent	-0.109**	-0.121**	-0.122*	-0.098*	-0.108**	-0.122**
	(0.039)	(0.040)	(0.050)	(0.039)	(0.039)	(0.040)
Married at 10 YOS	0.087**	0.071**	0.033	0.083**	0.086**	0.073**
	(0.026)	(0.027)	(0.032)	(0.026)	(0.026)	(0.027)
Dependents at 10 YOS	0.013	0.019	-0.003	0.012	0.009	0.020
	(0.020)	(0.020)	(0.023)	(0.020)	(0.020)	(0.020)
Black Non-Hispanic	-0.041	-0.054	-0.035	-0.050	-0.041	-0.048
	(0.048)	(0.048)	(0.058)	(0.047)	(0.048)	(0.048)
Asian	0.035	0.040	-0.044	0.039	0.032	0.040
	(0.047)	(0.048)	(0.060)	(0.047)	(0.046)	(0.048)
Hispanic	0.039	0.048	0.055	0.037	0.043	0.049
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Race Unknown	-0.023	0.021	0.061	-0.029	-0.035	0.012
	(0.051)	(0.049)	(0.046)	(0.050)	(0.049)	(0.049)
ROTC Graduate	0.126***	0.099***	0.079**	0.100***	0.077**	0.082***
	(0.022)	(0.023)	(0.026)	(0.022)	(0.023)	(0.024)
Naval Academy Graduate	0.105***	0.077**	0.073*	0.072**	0.073**	0.082**
	(0.024)	(0.026)	(0.031)	(0.026)	(0.026)	(0.028)
Other/Direct Commissioning Source	0.095***	0.097***	0.048	0.097***	0.097***	0.097***
	(0.024)	(0.025)	(0.028)	(0.024)	(0.024)	(0.025)
Cohort_FY00	-0.010	-0.031	-0.008	-0.010	-0.015	-0.032
	(0.031)	(0.031)	(0.031)	(0.031)	(0.030)	(0.031)
Cohort_FY01	-0.021	-0.034	-0.023	-0.017	-0.013	-0.032
	(0.029)	(0.029)	(0.031)	(0.029)	(0.029)	(0.029)
Cohort_FY02	-0.096***	-0.116***	-0.111***	-0.090**	-0.085**	-0.114***
	(0.029)	(0.029)	(0.032)	(0.029)	(0.029)	(0.029)
Cohort_FY03	-0.044	-0.068*	-0.073*	-0.046	-0.032	-0.064*

	(1) Retention at 15 YOS (0.029)	(2) Retention at 15 YOS (0.029)	(3) Retention at 15 YOS (0.034)	(4) Retention at 15 YOS (0.029)	(5) Retention at 15 YOS (0.029)	(6) Retention at 15 YOS (0.029)
STEM Degree		0.021 (0.017)				0.018 (0.017)
All STEM Education			0.024 (0.027)			
STEM BS & Non-STEM Grad Ed			0.013 (0.022)			
Non-STEM BS & STEM Graduate Degree			-0.108* (0.051)			
Biology Degree				-0.047 (0.051)		
Physical Sciences Degree				-0.021 (0.034)		
Math/CS Degree				0.075 (0.054)		
Engineering Degree				0.031 (0.022)		
Business/Econ Degree				0.021 (0.026)		
Humanities Degree				-0.063 (0.053)		
Other Degree				-0.110*** (0.027)		
High Ranked Univ					0.047* (0.021)	0.043* (0.021)
Low Ranked					-0.020	-0.016

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Univ						
					(0.052)	(0.052)
Unknown Ranked Univ					-0.130***	-0.026
					(0.029)	(0.040)
Constant	0.641***	0.686***	0.826***	0.666***	0.665***	0.679***
	(0.033)	(0.034)	(0.039)	(0.034)	(0.033)	(0.035)
Observations	2790	2544	1380	2790	2790	2544
R^2	0.031	0.031	0.036	0.043	0.044	0.033

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

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APPENDIX D. SPECWAR FIFTEEN-YEAR RETENTION

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Female respondent	-0.105	0.066	0.028	-0.120	-0.088	0.085
	(0.232)	(0.244)	(0.268)	(0.206)	(0.236)	(0.248)
Married at 10 YOS	0.180	0.147	0.272	0.157	0.185	0.154
	(0.129)	(0.132)	(0.218)	(0.134)	(0.130)	(0.135)
Dependents at 10 YOS	-0.053	-0.036	-0.085	-0.053	-0.050	-0.034
	(0.097)	(0.096)	(0.123)	(0.096)	(0.099)	(0.097)
Black Non-Hispanic	-0.339	-0.267	0.000	-0.284	-0.314	-0.253
	(0.354)	(0.371)	(0.000)	(0.289)	(0.366)	(0.382)
Asian	0.087	0.085	0.348	0.135	0.099	0.085
	(0.188)	(0.175)	(0.191)	(0.168)	(0.182)	(0.176)
Hispanic	-0.029	-0.024	-0.133	-0.002	-0.031	-0.027
	(0.127)	(0.143)	(0.174)	(0.128)	(0.132)	(0.147)
Race Unknown	0.080	0.029	-0.201	0.057	0.075	0.026
	(0.144)	(0.136)	(0.165)	(0.138)	(0.149)	(0.142)
ROTC Graduate	0.035	-0.027	-0.156	-0.079	0.022	-0.023
	(0.102)	(0.105)	(0.173)	(0.100)	(0.116)	(0.118)
Naval Academy Graduate	0.102	0.015	0.076	-0.041	0.129	0.044
	(0.109)	(0.118)	(0.129)	(0.115)	(0.127)	(0.135)
Other/Direct Commissioning Source	-0.175	-0.112	0.110	-0.288	-0.174	-0.120
	(0.240)	(0.242)	(0.208)	(0.193)	(0.267)	(0.262)
Cohort_FY00	0.032	-0.058	-0.123	-0.075	0.047	-0.051
	(0.141)	(0.142)	(0.167)	(0.137)	(0.146)	(0.149)
Cohort_FY01	0.048	-0.041	-0.256	-0.013	0.065	-0.036
	(0.133)	(0.135)	(0.174)	(0.146)	(0.142)	(0.146)
Cohort_FY02	-0.033	-0.093	-0.184	-0.075	-0.031	-0.094
	(0.129)	(0.131)	(0.173)	(0.134)	(0.132)	(0.133)
Cohort_FY03	0.134	0.051	-0.148	0.095	0.138	0.050

	(1) Retention at 15 YOS (0.129)	(2) Retention at 15 YOS (0.131)	(3) Retention at 15 YOS (0.199)	(4) Retention at 15 YOS (0.147)	(5) Retention at 15 YOS (0.132)	(6) Retention at 15 YOS (0.135)
STEM Degree		0.204*				0.200*
		(0.089)				(0.090)
All STEM Education			0.229			
			(0.134)			
STEM BS & Non-STEM Grad Ed			-0.119			
			(0.156)			
Non-STEM BS & STEM Graduate Degree			-0.310			
			(0.259)			
Biology Degree				0.464**		
				(0.139)		
Physical Sciences Degree				0.241		
				(0.153)		
Math/CS Degree				0.534***		
				(0.142)		
Engineering Degree				0.427***		
				(0.111)		
Business/Econ Degree				0.352**		
				(0.131)		
Humanities Degree				0.427*		
				(0.186)		
Other Degree				0.115		
				(0.140)		
High Ranked Univ					0.075	0.047
					(0.121)	(0.120)
Low Ranked					0.006	0.031

	(1) Retention at 15 YOS	(2) Retention at 15 YOS	(3) Retention at 15 YOS	(4) Retention at 15 YOS	(5) Retention at 15 YOS	(6) Retention at 15 YOS
Univ						
					(0.162)	(0.160)
Unknown Ranked Univ					0.029	0.065
					(0.165)	(0.180)
Constant	0.476**	0.521**	0.766**	0.394*	0.440*	0.488**
	(0.155)	(0.158)	(0.264)	(0.167)	(0.170)	(0.179)
Observations	158	154	65	158	158	154
R^2	0.061	0.092	0.243	0.194	0.064	0.094

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

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APPENDIX E. SPECWAR O-5 PROMOTION PROBABILITIES

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Female respondent	-0.416***	-0.355*	-0.623**	-0.249	-0.305*	-0.270
	(0.110)	(0.137)	(0.216)	(0.150)	(0.128)	(0.150)
Married at 10 YOS	0.114	0.089	0.256	0.120	0.122	0.096
	(0.152)	(0.154)	(0.231)	(0.146)	(0.149)	(0.153)
Dependents at 10 YOS	-0.080	-0.081	-0.135	-0.012	-0.057	-0.065
	(0.120)	(0.120)	(0.122)	(0.122)	(0.125)	(0.123)
Black Non-Hispanic	-0.505**	-0.408*	0.000	-0.354	-0.382*	-0.303
	(0.163)	(0.182)	(0.000)	(0.241)	(0.172)	(0.185)
Asian	-0.203	-0.199	0.364	-0.132	-0.122	-0.117
	(0.264)	(0.314)	(0.202)	(0.317)	(0.258)	(0.303)
Hispanic	0.063	0.133	-0.245	0.056	0.057	0.113
	(0.141)	(0.143)	(0.215)	(0.127)	(0.143)	(0.150)
Race Unknown	0.159	0.123	-0.054	0.252	0.212	0.180
	(0.188)	(0.173)	(0.157)	(0.220)	(0.172)	(0.157)
ROTC Graduate	0.082	0.012	0.055	-0.007	0.033	-0.022
	(0.118)	(0.126)	(0.171)	(0.125)	(0.126)	(0.130)
Naval Academy Graduate	0.192	0.101	0.092	0.075	0.241	0.157
	(0.130)	(0.141)	(0.178)	(0.143)	(0.146)	(0.160)
Other/Direct Commissioning Source	-0.522***	-0.488***	0.000	-0.526**	-0.682***	-0.648***
	(0.137)	(0.138)	(0.000)	(0.170)	(0.175)	(0.180)
Cohort_FY00	-0.036	-0.102	-0.070	-0.132	-0.026	-0.092
	(0.147)	(0.151)	(0.172)	(0.146)	(0.144)	(0.147)
Cohort_FY01	0.068	0.045	-0.186	0.021	0.132	0.104
	(0.138)	(0.142)	(0.185)	(0.140)	(0.144)	(0.152)
Cohort_FY02	-0.137	-0.194	-0.030	-0.185	-0.118	-0.180
	(0.136)	(0.138)	(0.179)	(0.136)	(0.137)	(0.139)

	(1) Promoted O-5 by 17 YCS	(2) Promoted O-5 by 17 YCS	(3) Promoted O-5 by 17 YCS	(4) Promoted O-5 by 17 YCS	(5) Promoted O-5 by 17 YCS	(6) Promoted O-5 by 17 YCS
Cohort_FY03	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
STEM Degree		0.169				0.164
		(0.111)				(0.112)
All STEM Education			0.240			
			(0.142)			
STEM BS & Non-STEM Grad Ed			0.021			
			(0.195)			
Non-STEM BS & STEM Graduate Degree			-0.467			
			(0.284)			
Biology Degree				0.115		
				(0.199)		
Physical Sciences Degree				-0.299		
				(0.175)		
Math/CS Degree				0.407*		
				(0.178)		
Engineering Degree				0.372**		
				(0.127)		
Business/Econ Degree				-0.104		
				(0.188)		
Humanities Degree				0.013		
				(0.223)		
Other Degree				-0.181		
				(0.141)		
High Ranked Univ					0.192	0.170
					(0.136)	(0.135)

	(1)	(2)	(3)	(4)	(5)	(6)
	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS	Promoted O-5 by 17 YCS
Low Ranked Univ					0.131	0.157
					(0.198)	(0.204)
Unknown Ranked Univ					-0.101	-0.110
					(0.184)	(0.216)
Constant	0.460**	0.497**	0.645*	0.480**	0.374*	0.417*
	(0.173)	(0.178)	(0.294)	(0.181)	(0.180)	(0.191)
Observations	123	119	56	123	123	119
R^2	0.111	0.137	0.337	0.244	0.136	0.158

Standard errors in parentheses (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). Column 2 and 6 contain a lower number of observations to account for missing STEM educational variables. Column 3 contains the lowest amount of observations to consider only officers who have obtained graduate level education. We included robust standard errors to our estimates to account for heteroscedasticity in the models and make sure that our estimates had the most accurate standard errors.

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APPENDIX F. SUMMARY STATISTICS FOR OFFICERS AT 10 YOS

Summary Statistics	Mean	Standard Deviation	OBS
Dependent Variables			
Fifteen Year Retention	0.751	0.432	8,565
Promoted O-5	0.473	0.499	8,565
Independent Variables			
Demographics			
Female	0.133	0.339	8,565
Male	0.866	0.339	8,565
Married_10	0.806	0.395	8,190
Not_Married_10	0.194	0.395	8,190
Dep_Child_10	0.603	0.489	8,190
No_Dep_Child_10	0.397	0.489	8,190
White_NonHispanic	0.751	0.432	8,565
Black_NonHispanic	0.08	0.271	8,565
Asian	0.05	0.216	8,565
Hispanic	0.087	0.282	8,565
Other_Unkn_Race	0.033	0.179	8,565
Commissioning Source			
Naval Academy	0.221	0.415	8,565
NROTC	0.22	0.414	8,565
OCS_OTS_PLC	0.364	0.481	8,565
Direct/Other Commissioning	0.194	0.395	8,565
URL Community Designator			
SWO	0.193	0.394	8,565
SUB	0.073	0.26	8,565
Special Warfare (SPEC)	0.02	0.139	8,565
Aviator	0.341	0.474	8,565
Unqual_Line	0.108	0.31	8,565
Cohort Year			
Cohort FY99	0.188	0.391	8,565
Cohort FY00	0.203	0.402	8,565
Cohort FY01	0.209	0.407	8,565
Cohort FY02	0.208	0.406	8,565
Cohort FY03	0.192	0.394	8,565
Education Variables			

Summary Statistics	Mean	Standard Deviation	OBS
STEM Degree	0.509	0.499	7,873
Non STEM Degree	0.491	0.499	7,873
Engineering	0.245	0.43	8,565
Mathematics	0.02	0.141	8,565
Physical Sciences	0.083	0.277	8,565
Social Sciences	0.198	0.398	8,565
Humanities	0.027	0.162	8,565
Business	0.131	0.337	8,565
Biology	0.03	0.171	8,565
Other Major	0.213	0.41	8,565
Graduate Education	0.677	0.467	7,837
STEM Graduate Education	0.248	0.432	7,837
All STEM Education	0.185	0.388	7,837
STEM Undergrad & Non STEM Grad	0.151	0.358	7,837
Non STEM Undergrad & STEM Grad	0.062	0.241	7,837
All Non STEM Education	0.278	0.448	7,837
University Competitiveness High	0.201	0.401	8,565
University Competitiveness Medium	0.333	0.471	8,565
University Competitiveness Low	0.052	0.222	8,565
University Competitiveness UNKNOWN	0.136	0.343	8,565

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